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Racial/Ethnic Differences in Treatment of Attention Deficit/Hyperactivity Disorder among Children

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Abstract

Racial/Ethnic Differences in Treatment of Attention Deficit/Hyperactivity Disorder among Children

By Jiani Zhou

Objectives

Attention Deficit/Hyperactivity Disorder (ADHD) is one of the most common disorders among children, while also having low treatment rates. According to the American Academy of Pediatrics (AAP), clinical guidelines for ADHD treatment vary according to the age of the child. Although race/ethnicity has been identified as a key predictor in mental health (MH) services use, few studies have examined its role in ADHD treatment with a national sample. To address this gap, this study examined racial/ethnic differences in ADHD treatment using a nationally representative sample of children that have received an ADHD diagnosis by a health care provider.

Methods

The 2009-2010 National Survey of Children with Special Health Care Needs (NS-CSHCN) was used as the data source to derive a nationally representative sample of 8,799 children aged 4-17 years with current ADHD. Racial/ethnic differences in ADHD treatment were examined using weighted logistic regressions, by age group, adjusted for demographics, socioeconomic characteristics, health status, and contextual factors.

Results

Among children aged 6-11 years, non-Hispanic black children (ME=-0.050 percentage points; SE=0.02) and children from other racial/ethnic groups (ME=-0.070 percentage points; SE=0.02) were less likely than non-Hispanic white children to receive guideline-concordant treatment (i.e., medication or behavioral therapy) for their ADHD, controlling for sociodemographic factors, health status, and contextual factors.

Among children aged 12-17 years, non-Hispanic black children (ME=-0.106; SE=0.03) and children from other racial/ethnic groups (ME=-0.079; SE=0.004) were less likely than non-Hispanic whites to receive guideline-concordant treatment (i.e., medication), controlling for covariates. These differences were partially explained by whether the child had a usual source of care and parent-perceived severity of ADHD.

Conclusion

The findings of this study highlight lower rates of guideline-concordant treatment for ADHD among racial/ethnic minority children compared to non-Hispanic whites. Future studies should seek to use appropriate data and qualitative methods to examine other pathways that account for racial/ethnic differences in the receipt of ADHD treatment.

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INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is usually diagnosed in childhood, which can result in severe impairment in several dimensions of children's lives and development, including having difficulty paying attention, controlling impulsive behaviors, and taking unnecessary risks.[1-8] These behavioral problems may have other detrimental consequences, such as poor academic performance and unintentional injury, as well as long-term adverse outcomes such as criminal activities.[1-4,6,9] Although prevalence estimates vary by assessment and diagnostic criteria, the high prevalence of ADHD among children has been well documented.[10,11] The number of children who had ever been diagnosed with ADHD, as reported by parents, increased 42% from 2003 to 2011.[12] In 2011, more than one in ten children aged 4 to 17 years had ever been diagnosed with ADHD, and 8.8% of this age group had current ADHD.[12]

In 2011, the America Academy of Pediatrics (AAP) released new ADHD treatment guidelines for youth between the ages of 4 and 18 years.[13] According to current AAP guidelines, the recommendations for treatment of ADHD among children can vary, depending on the patient's age. For elementary school-aged children who are 6-11 years of age, Food and Drug Administration (FDA)-approved medications and/or evidence-based behavioral therapy are recommended, and a combination of both medication and behavioral therapy is preferred.[13] For adolescents aged 12-17 years, the use of an FDA-approved medication alone is recommended, and combined treatment with medication and behavioral therapy is preferred.[13]

Despite growing attention and understanding regarding ADHD and the availability of evidence-based treatments, rates of ADHD treatment are low among

children aged 4-17 years with ADHD. Only one-third of elementary school-aged children received the preferred treatment with medication and behavioral therapy for their disorders, and less than 30% of children aged 12-17 years used the preferred treatment, as the AAP guideline recommended.[14] In addition to low treatment initiation rates, a large percentage of children discontinue their ADHD treatment within the first few months due to side effects and parent-perceived inefficiency of treatments.[15-18]

Studies have identified that race/ethnicity as one of the major factors associated with the receipt of mental health (MH) treatment among children.[19-27] Relative to non-Hispanic whites, non-Hispanic black and Hispanic children appear to use significantly fewer services for MH disorders including major depression, anxiety, and substance abuse disorders.[21-27] In addition, compared to non-Hispanic whites, minority children are less likely to initiate and more likely to discontinue ADHD medication.[28-39 14,40] Studies have identified a number of barriers that can explain the differences in treatment across racial/ethnic groups, such as stigma toward mental disorders and treatments, financial difficulties, lack of health insurance, and limited English proficiency.[41-44]

Although there are increasing numbers of studies examining racial/ethnic differences in ADHD treatment among children, most of these studies have used state Medicaid claims data.[29-32,34,40] In addition, most of these prior studies have not created measures of ADHD treatment based on clinical guidelines for each age group. To address these gaps in the literature and obtain nationally generalizable results, this study used data from the National Survey of Children with Special Health Care Needs (NS-CSHCN) to examine the association between race/ethnicity and the receipt of ADHD

treatment among children. I hypothesized that minority children are less likely to receive guideline-concordant treatment for ADHD compared to non-Hispanic white children.

LITERATURE REVIEW

ADHD among U.S. children

ADHD is a neurodevelopmental disorder characterized by significant functional impairment, including persistent inattention, hyperactivity, and impulsivity.[45] This MH condition includes three subtypes: predominantly hyperactive impulsive, predominantly inattentive, and combined hyperactive-impulsive and inattentive.[45] ADHD is usually diagnosed in childhood and can continue to impair individuals through adulthood.[7] More than one-half of children with ADHD continue to experience symptoms and impairment in adulthood.[8]

The estimates of ADHD prevalence among children vary across data sources. The American Psychiatric Association (APA) estimates that 5% of children have ever been diagnosed with ADHD.[45] Using data from a parent survey in 2011, the Centers for Disease Control and Prevention (CDC) reported that more than one in ten children/adolescents aged 4 to 17 years had ever received an ADHD diagnosis by a health care provider and that 8.8% of this age group had current ADHD. Furthermore, the rates of current parent-reported ADHD in this survey for non-Hispanic white, non-Hispanic black, and Hispanic children were 8.7%, 9.8%, and 5.0%, respectively.[12] [12] It is also noteworthy that the number of children with a parent-reported history of ADHD dramatically increased by 42% from 2003 to 2011.[12] The rapid rise in the parent-reported prevalence of ADHD may be attributed to improvements in diagnostic criteria and

increased health education and awareness of ADHD, as well as an actual increase in underlying prevalence of this MH disorder.[7,12,13]

Research has shown that ADHD can cause severe impairment in several dimensions of children's lives and development, including difficulty paying attention, controlling impulsive behaviors, and taking unnecessary risks.[1-6] These behavioral problems may have additional detrimental consequences. For example, studies have shown that children with ADHD may have difficulty making friends and getting along with others.[46] Poor academic performance is another important consequence, as children with ADHD have trouble sitting still, focusing attention, and processing information.[3,9] Additionally, studies have shown that ADHD is one of the important predictors of unintentional injury. Children with ADHD have a two-fold higher risk for injury than children who are not diagnosed with ADHD [1,2,6] Moreover, children with ADHD are at increased risk for involvement in criminal activities such as theft, violence, and illegal drug use because of the impulsive nature of their disorders, poor education outcomes, and lower labor market expectations.[4] Finally, ADHD is associated with high medical expenditures. Compared to children without ADHD, a child with ADHD increases the annual economic burden to his/her parents by $200 to $1,500.[47]

AAP Guidelines for the Diagnosis, Evaluation, and Treatment of ADHD

Although ADHD cannot be cured, several treatment options can reduce core symptoms associated with this disorder. Pharmacological treatment and behavioral therapy are two evidence-based treatments for ADHD. Currently, there are several FDA-approved medications that have been shown to reduce core symptoms associated with

ADHD: stimulants (e.g., amphetamines and methylphenidates) and nonstimulants (e.g., guanfacine extended release and atomoxetine).[13,33] As a non-medical treatment, behavioral therapy is designed to improve problem behaviors of children with ADHD through different types of training, including behavioral management training for parents and classroom behavioral management.[13,48-50]

In 2011, the American Academy of Pediatrics (AAP) released the new guidelines for diagnosis, evaluation, and treatment of ADHD for children between the ages of 4 and 18 years of age.[13] According to the current AAP guidelines, the ADHD treatment recommendations depend on the age of the child. For preschool-aged children who are 4-5 years of age, the first-line treatment is evidence-based behavioral therapy; if this type of intervention does not improve children's condition or if children experiences moderate to severe symptoms, methylphenidate may be used after weighing the risks of side effects. For elementary school-aged children who are 6-11 years, the U.S. Food and Drug Administration (FDA)-approved medications and/or behavioral therapy are recommended as treatment for ADHD, and a combination treatment of both medication and behavioral therapy is preferred. For adolescents who are 12-18 years, the FDA-approved medications alone are recommended, and a combination treatment with behavioral therapy is preferred.[13]

According to the latest study released by the CDC, approximately 90% of elementary school-aged children with current ADHD took medications in the past week or received behavioral therapy in the past 12 months, but only one-third received the preferred treatment of both medication and behavioral therapy.[14] The situation is even worse for adolescents. Less than half of adolescents with current ADHD took

medications in the past week (i.e., the recommended treatment), and only 27% received the preferred treatment of both medication and behavioral therapy.[14]

Table 1. Treatment guidelines/recommendations for ADHD[13]

Age groups	Recommended treatment	Preferred treatment
Preschool-age children (4-5 years)	Behavioral therapy (Methylphenidate if needed)	N/A
Elementary school-aged children (6-11 years)	Medication and/or behavioral therapy	Combination of medication and behavioral therapy
Adolescents (12-18 years)	Medication alone	Combination of medication and behavioral therapy

Racial/Ethnic Differences in MH Services Use

Studies examining racial/ethnic disparities in the receipt of MH services have found that the proportion of underserved children with MH disorders is higher for minority groups compared to non-Hispanic whites.[21-27] Overall, Hispanic and non-Hispanic black children have significantly lower treatment rates for MH disorders relative to their non-Hispanic white counterparts.[25-27] For example, among adolescents, the adjusted percentage of black, Hispanic, and Asian youth who received any treatment for major depression is significantly lower than the corresponding percentage of non-Hispanic white youth.[51] In addition, Hispanic (3.7%) and black (4.4%) adolescents use less outpatient care for their MH disorders than white adolescents (8.2%).[19,27]

Studies focusing on use of pharmacological treatment for ADHD have also found differences by racial/ethnic groups. Overall, ADHD pharmacotherapy use rates are lower for racial/ethnic minority children than non-Hispanic white children, which may be

explained, in part, by geography and provider setting.[29,31-36] In addition, non-Hispanic black and Hispanic children are less likely to initiate use of ADHD medication compared to non-Hispanic whites.[34,37,38] Moreover, non-Hispanic black and Hispanic children are more likely than non-Hispanic white children to discontinue ADHD medication, after controlling for other confounders.[28-31,37-39]

However, among children aged 4-17 years that have received an ADHD diagnosis by a health care provider, minority children are more likely to use behavioral therapy for their ADHD relative to non-Hispanic whites.[14] A study has also found that among Medicaid-enrolled children aged 6-12 years, nonwhite children are more likely to initiate psychosocial interventions than white children.[40]

Studies have identified a number of factors that are correlated with minority race/ethnicity that can explain the differences in MH treatment, such as cultural stigma toward mental disorders and treatments, limited English proficiency, lack of health insurance, and parent-perceived severity of MH problems.[41-44] First, stigma -- an attribute characterized by feelings of shame and isolation -- is regarded as one of the primary barriers to use of MH treatment among racial/ethnic minority groups.[42] Hispanic and non-Hispanic blacks view psychotropic medication less favorably than whites.[41] Stigmatizing views are also related to parents' concerns about the impact that diagnosis and treatment would have on the child's self-confidence and success in the future.[42]

In addition, English language proficiency is considered to be an important enabling factor when seeking MH treatment. When an individuals' primary language is not English, they may not be able to communicate and receive MH services effectively in English.[52] Minority parents and/or children with limited English proficiency are

significantly more likely to discontinue MH services compared to whites, English-speaking children, after controlling for sociodemographic and geographic characteristics.[44,53]

Furthermore, compared to non-Hispanic whites, non-Hispanic blacks and Hispanics are more likely to be uninsured, which, in turn, may lead to lower rates of MH service utilization.[25,54]

Finally, parent-perceived severity of the child's symptoms also has an impact on the receipt of MH treatment. Parents have the strongest influence over childrens' decisions to seek MH services.[55] Research has shown that parents of non-Hispanic black children are less likely to report severe symptoms and need of MH services than non-Hispanic white parents.[56]

In addition to the barriers discussed above, having a usual source of care (USOC) and medical homes can affect children's receipt of MH services. Children with a USOC or a medical home have better access to health care services than those do not.[57-59] Furthermore, studies using national data have shown that children without a USOC or a medical home are more likely to report unmet MH needs.[60,61] Relative to non-Hispanic white, minority children and adolescents are less likely to have a USOC or a medical home, which may explain the racial/ethnic differences in the receipt of MH services.[62,63]

Gaps in Literature

Although the literature on the racial/ethnic differences in MH treatment among youth is growing, less is known about racial/ethnic differences in ADHD treatment, as national studies of this issue are rare. Studies have shown that ADHD treatment patterns

vary among children by gender, age and region,[14] but no research has comprehensively examined differences in ADHD treatment patterns among racial/ethnic groups using a national sample. In addition, although a number of studies have examined racial/ethnic differences in pharmacological treatment for ADHD using Medicaid administrative databases,[28-32,34] few studies assessed the association between race/ethnicity and the receipt of behavioral therapy and preferred combination treatment.

To address the gaps in the literature, this study examined the racial/ethnic differences in the receipt of ADHD treatment among U.S. children using a nationally representative dataset. One important study by Visser et al. assessed the overall treatment patterns among U.S. children adjusted by demographic factors, which provided a general picture of ADHD treatment among children (CITE THIS STUDY). This study did not, however, analyze the racial/ethnic differences using multivariate methods nor the pathways that might explain the differences.

To build upon the existing literature, I draw on the AAP guidelines to create dependent variables that assess the receipt of guideline-concordant treatment. Additionally, I examined three potential factors that may explain the differences in the receipt of ADHD treatment by racial/ethnic groups, including (1) having a USOC and a medical home, (2) English language proficiency, and (3) parent-perceived severity of the child's ADHD.

METHODS

Conceptual Framework

Andersen's Behavioral Model of Health Care Services Use is employed as the basis of the conceptual framework of this study.[64] The Andersen Model describes how individual characteristics and contextual factors affect one's utilization of health care services. The initial model incorporates three categories of determinants of health services use: predisposing, enabling, and need characteristics. Predisposing characteristics refer to anything that might predispose a person to require and use a particular service, which include demographic factors (e.g., age and gender), social structures (e.g., household structure), and health beliefs. Enabling characteristics are factors that facilitate or impede an individual's health behavior, encompassing individual resources (e.g., language, parent education level, household income, insurance, USOCs, and medical homes) and community resources (e.g., availability of health care provider). Need characteristics are directly correlated with use of health services, and include both perceived need for services (e.g., parent perception of the child's ADHD severity) and evaluated need for services (e.g., professional assessments of MH disorders).

Figure 1 illustrates the conceptual frameworks used in this study. The unmeasured constructs (e.g., attitude, stigma, and supply of health care provider) are denoted with dashed boxes.

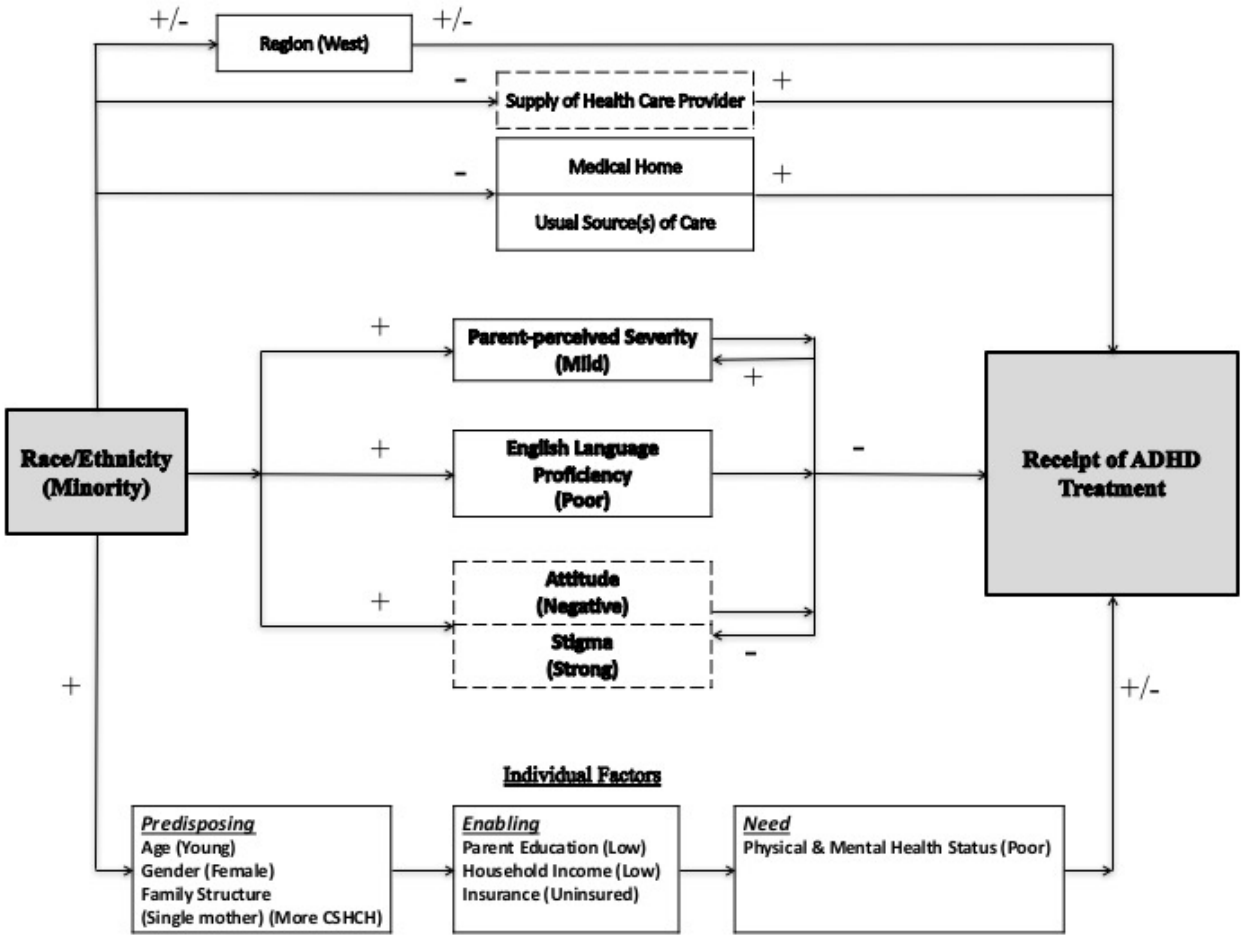


Figure 1. Conceptual framework for racial/ethnic difference in treatment of Attention Deficit/Hyperactivity Disorder among Children

Focal Relationship

The independent variable of interest is *race/ethnicity*. Studies have reported that race/ethnicity is one of the most important predisposing factors that affect MH services use among children.[21-27,33,34,37,39,51] In this study, race/ethnicity is categorized into the following four groups: non-Hispanic white, non-Hispanic black, Hispanics, and other race/ethnicity. Other race/ethnicity includes those who self-identify as non-Hispanic Asian, Alaskan Native, American Indian, and mixed race.

The dependent variable of interest is *receipt of ADHD treatment,* which is defined as seeking and using medication in the past week and/or behavioral therapy in the past 12 months for this MH condition.

Pathways

Race/ethnicity may be associated with the receipt of ADHD treatment through several pathways including stigma and attitude toward MH problems, English language proficiency, and parent-perceived severity of the child's symptoms.

Stigma has been defined as an attribute characterized by feelings of shame and isolation, which may influence people's perception of need and use of health care services.[64,65] Similarly, *health attitudes and beliefs* refers to personal cognitions and views that can affect one's health behaviors, formed by prior experience and environment.[64] Research has suggested that stigma and negative attitudes toward MH disorders and services are important barriers to seeking MH treatment among minority children.[41-43,51] In addition, these two factors may also influence treatment patterns and continuity of treatment.[41,66]

English language proficiency is defined as an individual's ability to communicate or perform in English.[67] Racial/ethnic minority children with limited English proficiency or that have parents with limited English proficiency may face barriers when seeking MH services.[44,52,53]

Parent-perceived severity of the child's symptoms refers to the level of severity of the child's disorder determined by the parents.[56] Minority parents with strong cultural and ethnic affiliations may hold more "permissive threshold" of their children's MH problems, and may be more likely to accept alternative explanations for their children's mental disorders.[68,69] Preservation of minority culture and stigma toward MH disorders affect parents' perception of their children's symptoms and need of MH services.[43,56] Thus, minority children may use guideline-concordant treatment less, on average, due to milder symptoms reported by their parents.

Confounders

The confounders shown in the conceptual framework consist of individual-level predisposing, enabling, and need characteristics, as well as other contextual and system-level factors.

Predisposing characteristics

Demographic factors include age and gender. Older age is positively associated with use of MH treatment.[70] Additionally, boys are more likely to use MH treatment for their ADHD.[14,71]

Family structure refers to the number of adult individuals in a family and their biological relationship to offspring.[72] Racial/ethnic minority children are more likely to

live in single parent households and are more likely to live in a household with at least one CSHCN.[39]

Enabling characteristics

Parent education refers to the father's and mother's knowledge and skills that are obtained from systematic instruction, which is positively associated with children's MH services use.[9,73,74] Relative to whites, minority children are more likely to have parents with lower education levels.[77]

Household income is defined as the combined amount of money earned by all persons living in a place of residence.[75] Racial/ethnic minority families have average lower household income than non-Hispanic white families, which can translate into lower MH services use.[28,56]

Insurance protects individuals from income loss due to medical expenses.[76] Compared to non-Hispanic whites, the likelihood of being uninsured is greater for minority children.[77] Therefore, the uncovered expenses may impede racial/ethnic minority children from seeking treatment for their disorders.

Need characteristics

Physical and MH status can be defined as overall physical fitness and emotional well-being of an individual.[78] A study using a national dataset has shown that minority children are more likely than white children to have more comorbid conditions along with ADHD.[79] Additionally, research has shown that impairment and comorbidity are positively associated with use of MH services.[26]

Contextual characteristics

Region is a geographic area divided by physical and human impact characteristics.[80] Studies have shown that region of residence can help to explain differences in medication and psychotherapy utilization.[31,81]

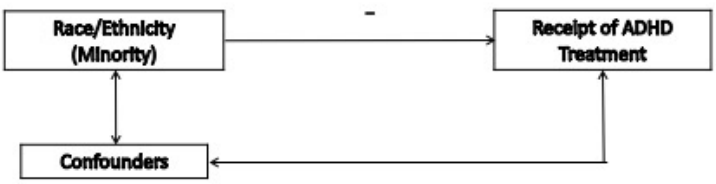
Supply of health care providers is one of the healthcare resources that affects access to MH services.[64] Compared to non-Hispanic whites, minority children are reported to lack health care providers, such as personal doctors and nurses.[25,82]

Medical home is a model of health care delivery for primary health care, and it encompasses five core components and characteristics: comprehensive care, patient-centered care, coordinated care, accessible services, and quality and safety.[83] *Usual Source(s) of care (USOC)*, an important component of a medical home, is defined as a place where individual usually goes when sick.[57] The likelihood of having a USOC or a medical home is significant lower for minority children than non-Hispanic whites.[62,63] This disparity may result in less MH treatment use for minority children.[63]

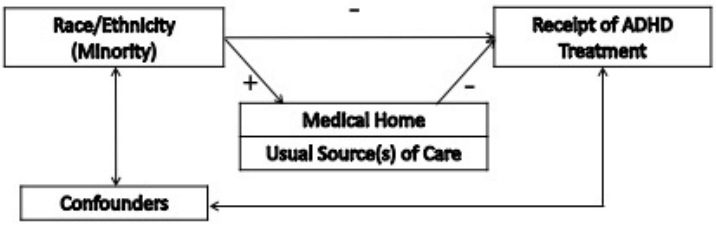
Hypothesis

This study examined the racial/ethnic differences in treatment of ADHD among children by the four racial/ethnic groups (e.g., non-Hispanic whites, non-Hispanic blacks, Hispanics, and other races/ethnicities). Specifically, the study tested the following hypotheses:

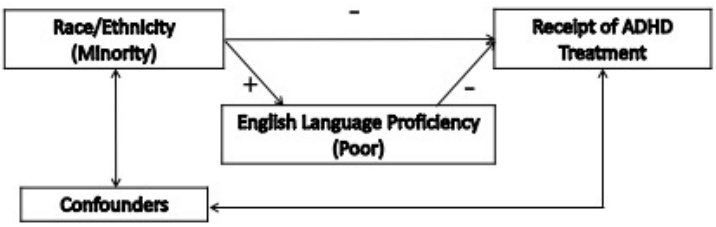
H1: Racial/ethnic minority children are less likely to receive ADHD treatment compared to non-Hispanic white children, after controlling for covariates.



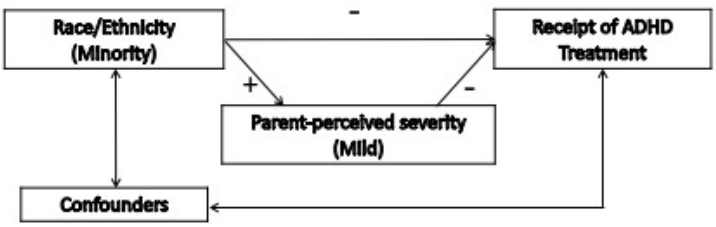
H1A: The negative relationship between minority race/ethnicity and the receipt of ADHD treatment is partially explained by having a USOC/a medical home.



H1B: The negative relationship between minority race/ethnicity and the receipt of ADHD treatment is also explained by English language proficiency.



H1C: The negative relationship between minority race/ethnicity and the receipt of ADHD treatment is further explained by parent-perceived severity of ADHD.



Construct Measurement

Receipt of guideline-concordant ADHD treatment – Parents were asked whether they had been informed by a doctor or other health care provider that their children had Attention Deficit Disorder (ADD) or ADHD, and if so, whether the children currently had ADD or ADHD. If the selected children currently had ADD or ADHD, the parents were asked if any medication was used during the past week for their child's ADD or ADHD. They were also asked whether their children received any behavioral treatment for ADD and ADHD, including "classroom management, peer interventions, social skills training, or cognitive behavioral therapy" in the past 12 months.

The AAP guidelines recommend medication and/or behavioral therapy for children aged 6-11 years, and the combination treatment of medication and behavioral therapy is preferred.[13] Therefore, for children who are 6-11 years old, I created four dichotomous indicators to assess the receipt of guideline-concordant treatment: (1) any medication in the past week; (2) any behavioral therapy in the past 12 months; (3) either medication in the past week or behavioral therapy in the past 12 months (recommended

treatment); and (4) both medication in the past week and behavioral therapy in the past 12 months (preferred treatment).

Medication alone is recommended for children aged 12-17 years, and the combination therapy of medication and behavioral therapy is preferred.[13] Therefore, for children aged 12-17 years, the receipt of guideline-concordant treatment is measured using four dichotomous indicators: (1) any medication in the past week (recommended treatment); (2) any behavioral therapy in the past 12 months; (3) either medication in the past week or behavioral therapy in the past 12 months; and (4) both medication in the past week and behavioral therapy in the past 12 months (preferred treatment).

Race/ethnicity – Race/ethnicity is classified into four mutually exclusive categories: non-Hispanic white (reference), non-Hispanic black, Hispanics, and other. Other race/ethnicity includes those who self-identify as non-Hispanic Asian, Alaskan Native, American Indian, and mixed race.

Parent-perceived severity – If children currently had ADD or ADHD, parents were asked to describe the severity level. Parent-perceived severity is captured by a 3-level categorical variable (mild (reference), moderate, or severe).

Language spoken at home – A dichotomous indicator is derived from a question in which the respondents were asked what is the primary language spoken at home, with 0 representing only English spoken at home (reference) and 1 representing a language other than English spoken at home.

Predisposing characteristics –Age is assessed with a continuous variable in years at the time of interview. Gender is assessed with a dichotomous indicator for female.

Family structure is assessed using two variables. First, a categorical measure of family status indicates children who live with (1) two parents (reference); (2) single mother; and (3) other adults. Second, number of CSHCN in household is measured with a dichotomous indicator of more than one CSHCN in household (versus only one CSHCN in household).

Enabling characteristics – Based on reported highest education level completed, a variable with three categories (e.g., less than high school (reference), high school graduate, and more than high school) is used to assess parent's education. Household financial resources are assessed using a categorical variable identifying Federal Poverty Level (FPL), including four levels: <100% FPL (reference), 100%-199% FPL, 200%-399% FPL, and ≥ 400% FPL. Health insurance is measured with a categorical variable. Children are categorized as having any private insurance (reference), public coverage, other insurance coverage, and no insurance.

Need characteristics – Parents were asked whether they had ever been informed by a doctor or other health care provider that the child had (1) depression; (2) anxiety problems; (3) behavioral conduct problems; (4) autism, Asperger's Disorder, pervasive development disorder, or other autism spectrum disorder (ASD); (5) development delay; (6) intellectual disability or mental retardation; (7) asthma; (8) migraines or frequent headaches; (9) allergies; (10) diabetes; (11) epilepsy or seizure disorder; (12) head injury, concussion, or traumatic brain injury; (13) heart problem (including congenital heart disease); (14) blood problems (such as anemia or sickle cell disease); (15) cystic fibrosis; (16) cerebral palsy; (17) muscular dystrophy; (18) Down syndrome; and (19) arthritis or joint problems. Physical and MH status are assessed by ten dichotomous indicators for

comorbid conditions, including indicators for the first nine comorbid conditions and one indicator combining the remaining comorbid conditions, due to their relatively small sample sizes.

Region – Region is assessed with a categorical variable that includes West (reference), Midwest, South, and Northeast. The categorical measure is derived based on children's state of residence, consistent with the classification created by the U.S. Census Bureau, Geography Division.[84]

USOC/Medical home – Parents were asked a series of questions about children's access to the five sub-components of having a medical home, including whether their child had a personal doctor or nurse, had a USOC, received family-centered care, received needed referrals, and received effective care coordination. Children must have a personal doctor or nurse and a USOC to meet the criteria of having a medical home, regardless of their experience of family-centered care, need referrals, and effective care coordination. The dichotomous indicator of medical home is provided by the data. USOCs and medical homes are captured with a categorical variable identifying children's access to USOCs and medical homes, including three categories: (1) has neither a USOC nor a medical home (reference); (2) has a USOC but not a medical home; and (3) has a medical home.

Table 2. Constructs and measures

Construct	Measure
Guideline-concordant treatment	***Use of ADHD guideline-concordant treatment***. • 6-11 years of age (4 dichotomous indicators): - Any medication - Any behavioral therapy - Any medication or behavioral therapy (recommended) - Both medication and behavioral therapy (preferred) • 12-17 years of age (4 dichotomous indicators): - Any medication (recommended) - Any behavioral therapy - Any medication or behavioral therapy - Both medication and behavioral therapy (preferred)
Race/ethnicity	***Race/ethnicity.*** Children will be classified into 4 racial/ethnic categories: • White (non-Hispanic) (reference) • Black (non-Hispanic) • Hispanic • Other (non-Hispanic)
Stigma	Unmeasured
Attitude	Unmeasured
Parent-perceived severity	***Parent-reported ADHD severity.*** Respondents will be categorized into three groups based on parent-reported ADHD severity: • Mild (reference) • Moderate • Severe
English language proficiency	***Language spoken at home.*** • Dichotomous indicators: • English only (reference) • Other than English
Age	***Age Group.*** • Continuous variable from 4 to 17 years
Gender	***Sex.*** Sex will be categorized as: • Male (reference) • Female

Table 2 (continued)

Family structure	***Parent status in family.*** Respondents will be categorized into 3 groups based on the question of family status: • Two parent (reference) • Single mother • Other family structure ***Number of CSHCN in household.*** Respondents will be categorized into 2 groups based on number of CSHCN in household: • One CSHCN (reference) • More than one CSHCN
Socioeconomic status	***Parent education level.*** Respondents will be classified into 3 groups based on highest education level of their parents in household: • Less than high school (reference) • High school graduate • More than high school ***Levels of income***. Respondents will be categorized into 4 poverty levels based on Federal Poverty Level (FPL) guidelines: • <100% FPL (reference) • 100-199% FPL • 200-399% FPL • 400% FPL or more
Health Insurance	***Health insurance coverage.*** A categorical variable will be created based on the questions of insurance type: • Any private insurance (reference) • Public insurance only • Other insurance coverage • Uninsured

Table 2 (continued)

Physical & mental health status	***Comorbidity.***
	• Dichotomous indicators:
	  • Depression
	  • Anxiety problems
	  • Behavioral conduct problems
	  • Autism, Asperger's Disorder, pervasive development disorder, or other ASD
	  • Development delay
	  • Intellectual disability or mental retardation
	  • Asthma
	  • Migraines or frequent headaches
	  • Allergies
	  • Other comorbidities

Region	***Region of U.S.*** Respondents will be categorized into 4 groups: • West (reference) • Midwest • South • Northwest
Supply of health care provider	Unmeasured

USOC/Medical home	***Has a USOC or a medical home.***
	• Categorical variable:
	  - Has neither a USOC nor a medical home (reference)
	  - Has a USOC but not a medical home
	  - Has a medical home

Data Source

The data for this study are drawn from the National Survey of Children With Special Health Care Needs (NS-CSHCN), a nationally representative, population-based telephone survey of parents with a child aged 0 to 17 carried out in the United States from July 2009 to March 2011.[85] Overall, 371,698 children were screened for special health care needs. Among parents that had a child with special health care needs

(CSHCN), a total of 40,242 detailed parent interviews were completed. The questionnaire was professionally translated into Spanish, Mandarin, Cantonese, Vietnamese, and Korean. The survey was designed to estimate the prevalence of special health care needs among children in the U.S. and to describe the medical home status, access to needed services, functional difficulties, and parent satisfaction with care. The survey provided information on family demographics, health care services, and presence of conditions, as well as other family and environmental factors affecting children's health behavior.

The NS-CSHCN was based on a complex survey design, with stratification by state, and children clustered within households (primary sampling unit). Using survey weights allows the data to be a representative sample of all non-institutionalized CSHCN in the U.S. The data were gathered through cellphone and landline interviews. The overall weighted response rate for the special health care needs screen was 25.5%, incorporating a 43.7% response rate for those interviewed via landline and a 15.2% response rate for those interviewed via cell phone. Among parents that had a CSHCN, the response rates of interview completion for landline households and cell phone families were 83.6% and 76.6%, respectively; the combined interview completion rate was 80.8%.

The Emory IRB gave exemption for review since this study uses secondary data that lack identifying information.

Analytical Sample

Among the 40,242 children with completed interviews in the NS-CSHCN between 2009 and 2010, 11,412 (28.4%) children had parent-reported current ADHD. This study excluded children with an invalid information about the questions concerning

ADHD treatment(n=1,875), children younger than 4 years (n=48), and children that had missing data on covariates (n=690). After applying the exclusion criteria, the overall analytical sample included 8,799 children aged 4 to 17 years with current ADHD (Figure 2). The subsamples for children aged 6-11 years and children aged 12-17 years were 3,937 and 4,606, respectively.

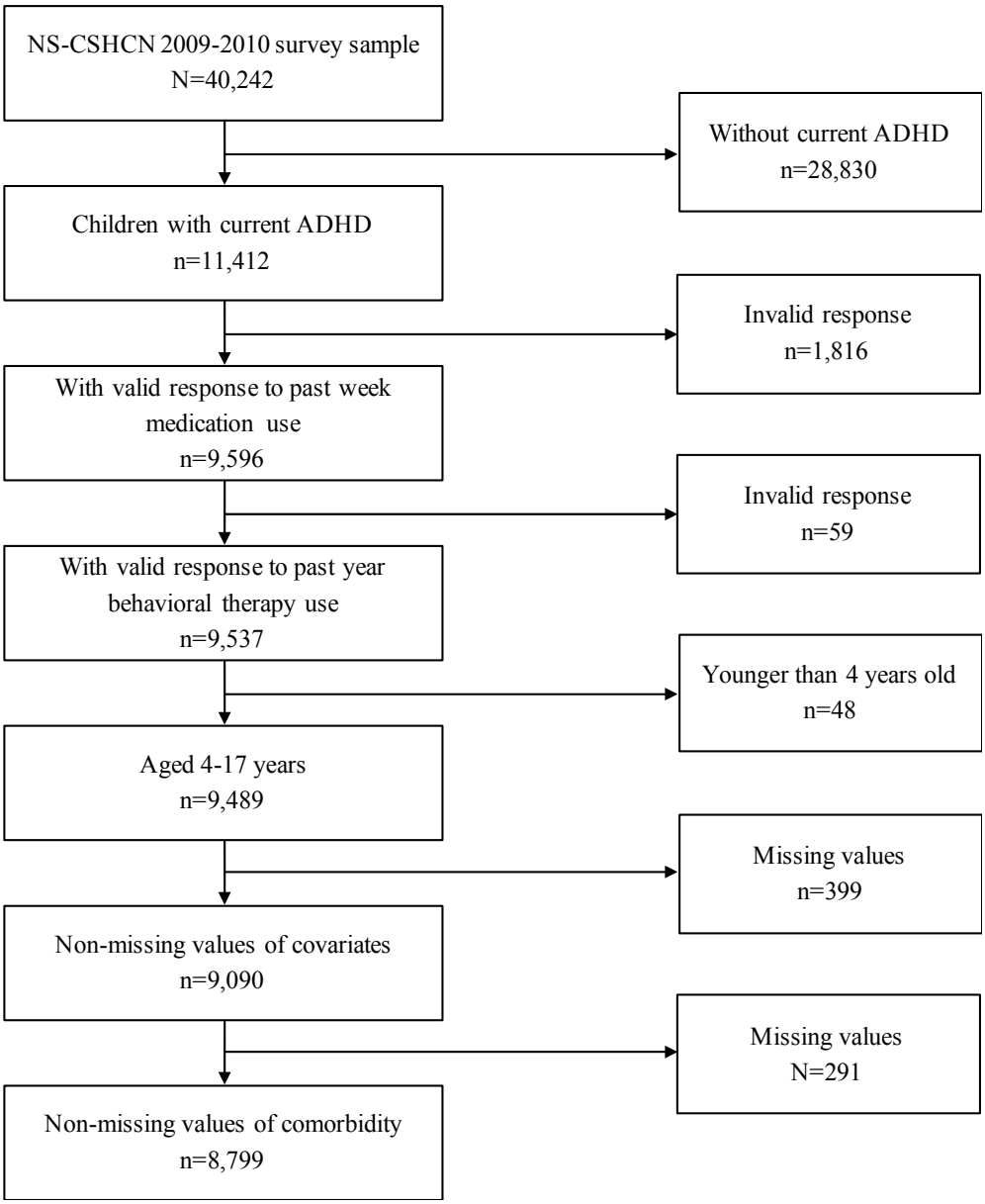


Figure 2. Analytic Sample

Analysis

Weighted analyses were conducted using Stata 14.1 software. All analyses were stratified by age group. Racial/ethnic differences among children aged 4-5 years were not examined due to insufficient sample size. First, descriptive analyses were implemented for the two subsamples for all model covariates. Adjusted Wald tests were used for bivariate analyses.

In addition to descriptive analyses, multivariate analyses were conducted with logistic regression models. Overall, four models were implemented to assess the relationship between key independent and dependent variables. Marginal effects were estimated at the observed values of the covariates for each minority racial/ethnic group versus non-Hispanic whites and were presented with standard errors (SE) in the regression tables.

Model 1 examined racial/ethnic differences in the receipt of ADHD treatment, adjusting for predisposing characteristics (e.g., age, gender, and family structure), socioeconomic status (e.g., parent education level, household income, and health insurance status), region of residence, and comorbidity. To assess whether having a USOC or a medical home accounts for any racial/ethnic differences, model 2 controlled USOC and medical home. Model 3 further controlled for language spoken at home to examine if language accounts for any racial/ethnic differences in ADHD treatment. Finally, Model 4 added parent-perceived severity of ADHD to assess whether parent's perception of the child's ADHD explains the differences by racial/ethnic groups.

Model 1

$$\ln\left(\frac{p(receiving\ treatment)}{1-p(receiving\ treatment)}\right) = \beta_0 + \beta_1 * \text{race/ethnicity} + \beta_2 * \text{age} + \beta_3 * \text{gender} + \beta_4 * \text{family status} + \beta_5 * \text{number of CSHCN in household} + \beta_6 * \text{region} + \beta_7 * \text{comorbidity} + \beta_8 * \text{parent education} + \beta_9 * \text{household income} + \beta_{10} * \text{health insurance} + \varepsilon$$

Model 2

$$\ln\left(\frac{p(receiving\ treatment)}{1-p(receiving\ treatment)}\right) = \beta_0 + \beta_1 * \text{race/ethnicity} + \beta_2 * \text{age} + \beta_3 * \text{gender} + \beta_4 * \text{family status} + \beta_5 * \text{number of CSHCN in household} + \beta_6 * \text{region} + \beta_7 * \text{comorbidity} + \beta_8 * \text{parent education} + \beta_9 * \text{household income} + \beta_{10} * \text{health insurance} + \beta_{11} * \text{has a USOC or a medical home} + \varepsilon$$

Model 3

$$\ln\left(\frac{p(receiving\ treatment)}{1-p(receiving\ treatment)}\right) = \beta_0 + \beta_1 * \text{race/ethnicity} + \beta_2 * \text{age} + \beta_3 * \text{gender} + \beta_4 * \text{family status} + \beta_5 * \text{number of CSHCN in household} + \beta_6 * \text{region} + \beta_7 * \text{comorbidity} + \beta_8 * \text{parent education} + \beta_9 * \text{household income} + \beta_{10} * \text{health insurance} + \beta_{11} * \text{has a USOC or a medical home} + \beta_{12} * \text{language spoken at home} + \varepsilon$$

Model 4

$$\ln\left(\frac{p(receiving\ treatment)}{1-p(receiving\ treatment)}\right) = \beta_0 + \beta_1 * \text{race/ethnicity} + \beta_2 * \text{age} + \beta_3 * \text{gender} + \beta_4 * \text{family status} + \beta_5 * \text{number of CSHCN in household} + \beta_6 * \text{region} + \beta_7 * \text{comorbidity} + \beta_8 * \text{parent education} + \beta_9 * \text{household income} + \beta_{10} * \text{health insurance} + \beta_{11} * \text{has a USOC or a medical home} + \beta_{12} * \text{language spoken at home} + \beta_{13} * \text{parent-reported ADHD severity} + \varepsilon$$

RESULTS

Descriptive Statistics: Children aged 6-11 years

The receipt of guideline-concordant treatment

Overall, 90.2% of children aged 6-11 years in the sample received any medication or behavioral therapy, as the AAP guidelines recommend (Table 3). Compared to non-Hispanic whites, children from other racial/ethnic groups were less likely to use the recommended treatment for their ADHD. This difference, however, was not significant. Only 34.5% of elementary school-aged children received both medication and behavioral therapy (i.e., preferred treatment) for their ADHD. Rates of preferred treatment ranged from 38.4% among non-Hispanic blacks to 28.7% among other racial/ethnic groups. Minority children were less likely to receive any medication and more likely to receive behavioral therapy relative to non-Hispanic white children. Adjusted Wald tests indicated that other racial/ethnic groups were significantly less likely than non-Hispanic whites to receive any medication ($p<0.001$), and that Hispanics were significantly more likely to use behavioral therapy relative to non-Hispanic whites ($p<0.05$).

Sociodemographics

Compared to non-Hispanic white children, non-Hispanic black children and Hispanic children were more likely to have parents with lower education level ($p<0.001$ and $p<0.01$, respectively), had significantly lower family income ($p<0.001$ and $p<0.01$, respectively), and were less likely to have private insurance ($p<0.001$ and $p<0.01$, respectively). Non-Hispanic blacks were also more likely than non-Hispanic whites to live in households with single mother ($p<0.001$).

Language, USOC/medical home, and parent-perceived severity

Hispanic children were more likely to speak another language at home than non-Hispanic whites ($p<0.001$). Minority children were also less likely to have a medical home ($p<0.001$) and a USOC ($p<0.01$, $p<0.001$, and $p<0.05$, respectively) compared to non-Hispanic white children. They did not, however, differ from non-Hispanic whites in parent-perceived severity of ADHD in the bivariate comparisons.

Comorbidity

Compared to non-Hispanic whites, non-Hispanic blacks were more likely to have behavioral or conduct problems ($p<0.001$), developmental delay ($p<0.05$), asthma ($p<0.001$), migraines or frequency headaches ($p<0.05$), and allergies ($p<0.01$). Hispanics were more likely than non-Hispanic whites to have asthma ($p<0.01$), and other racial/ethnic groups were more likely to have developmental delay ($p<0.01$) and asthma ($p<0.05$).

Table 3. Characteristics of children who are aged from 6 to 11 years and currently have ADHD by parent report, NS-CSHCN, 2009-2010

Characteristics	Race/Ethnicity % or mean (SE)				
	Total (N=3,937)	Non-Hispanic White (ref.) (n=2,813)	Non-Hispanic Black (n=393)	Hispanic (n=380)	Other (n=351)
Treatment					
Any medication	77.7	81.8	76.6	72.8	55.8***
Any behavioral therapy	47.0	44.3	48.7	55.3*	51.4
Any medication or behavioral therapy (recommended)	90.2	92.5	86.9	90.3	78.4
Both medication and behavioral therapy (preferred)	34.5	33.5	38.4	37.8	28.7
Female	28.6	29.3	30.2	26.2	24.2
Mean age (y) (SE)	8.9 (0.05)	8.9 (0.05)	8.7 (0.13)	9.2 (0.16)	9.0 (0.18)
Region					
West	15.7	12.9	6.8*	31.7***	28.2
Midwest	25.6	30.6	22.2*	8.0***	23.2
South	44.3	43.2	60.6***	34.2	38.5
Northeast	16.4	15.1	15.3	26.9**	10.4
Highest education of a resident parent					
Less than high school	11.2	7.1	22.9***	18.9**	7.7
High school graduate	23.3	22.4	27.4*	22.7	23.3
More than high school	65.5	70.6	49.6***	58.4*	69.1

Table 3 (continued)

Language spoken at home					
Other than English	3.0	0.2	0.5	19.6***	2.0
Family structure					
Two parents	60.1	69.7	23.5***	62.8	50.7**
Single mother	29.3	20.8	59.1***	27.8	40.1*
Other	10.7	9.5	17.4**	9.3	8.9
Number of CSHCN in household					
More than one	40.2	38.9	37.9	44.5	48.1
% Federal poverty level					
<100%	26.3	19.6	47.2***	34.2**	24.2
100%-199%	23.1	25.0	21.1	19.7	17.7
200%-399%	29.1	31.8	19.8**	25.1	33.0
≥400%	21.6	23.7	11.9**	21.0	25.1
Type of insurance					
Any private	50.2	58.1	29.6***	44.6**	42.0*
Public insurance (no private insurance)	43.6	36.1	67.2***	46.7*	51.4*
Other	3.2	3.2	1.2*	4.8	3.8
Uninsured	2.7	2.5	2.0*	3.9	2.7

Table 3 (continued)

Medical Home					
Has a medical home	38.8	45.6	31.0***	22.8***	28.2***
USOC but no medical home	52.2	46.6	58.8**	65.4***	60.5*
No USOC and medical home	9.0	7.8	10.3	11.8	11.2
Parent-perceived ADHD severity					
Mild	32.3	32.1	32.0	33.8	31.8
Moderate	44.9	47.0	40.8	42.4	39.9
Severe	22.8	20.9	27.2	23.8	28.3
Comorbidity					
Depression	13.4	12.8	13.4	15.8	14.4
Anxiety problems	27.7	28.2	23.5	32.0	24.7
Behavioral or conduct problems	29.7	26.4	43.0***	30.4	28.3
ASD	11.8	11.5	7.9	11.1	23.4
Developmental delay	26.1	22.9	29.9*	26.6	43.8**
Intellectual disability or mental retardation	6.6	5.3	6.6	6.4	17.8
Asthma	21.9	16.1	37.1***	29.2**	25.9*
Migraines or frequency headaches	9.6	7.6	15.4*	11.7	9.6
Allergies	41.0	39.8	46.5**	39.9	41.3
Any other physical comorbidities [a]	9.0	8.3	9.7	10.8	10.4

* p<0.05 ** p<0.01 *** p<0.001

[a] Other physical comorbidities includes diabetes, epilepsy or seizure disorder, head injury, concussion, or traumatic brain injury, heart problem, blood problems cystic fibrosis, cerebral palsy, muscular dystrophy, Down syndrome, and arthritis or joint problems

Descriptive Statistics: Children aged 12-17 years

The receipt of guideline-concordant treatment

Among children aged 12-17 years, 74.2% of children received medication for ADHD in the past week (recommended treatment), and 39.0% of children received any behavioral therapy (Table 4). Adjusted Wald tests indicated that compared to non-Hispanic whites, non-Hispanic blacks were less likely to receive any medication ($p<0.001$) and were more likely to received behavioral therapy ($p<0.05$). When examining the receipt of both medication and behavioral therapy (preferred treatment), treatment rates ranged from 27.3% among non-Hispanic blacks to 31.0% among other racial/ethnic groups. These differences across racial/ethnic groups were not in the rate of preferred treatment, however, statistically significant.

Sociodemographics

Relative to non-Hispanic white children, non-Hispanic black children and Hispanic children were more likely to have parents with lower education level ($p<0.001$ and $p<0.01$, respectively), lived with single mother ($p<0.001$ and $p<0.01$, respectively), had significantly lower family income ($p<0.001$), and were less likely to have private insurance ($p<0.001$).

Language, USOC/medical home, and parent-perceived severity

Hispanic children were more likely to speak a language other than English at home compared to non-Hispanic whites ($p<0.001$). Non-Hispanic blacks and Hispanics were less likely than non-Hispanic whites to have a medical home ($p<0.001$). Additionally, non-Hispanic black parents were more likely to describe their children's ADHD as "moderate" relative to non-Hispanic whites ($p<0.01$).

Comorbidity

Compared to non-Hispanic whites, non-Hispanic blacks were more likely to have depression ($p<0.01$), anxiety problems ($p<0.001$), behavioral or conduct problems ($p<0.001$), ASD ($p<0.05$), intellectual disability or mental retardation ($p<0.05$), asthma ($p<0.001$), and allergies ($p<0.01$). Hispanics were more likely than non-Hispanic whites to have ASD ($p<0.01$).

Table 4. Characteristics of children who are aged from 12 to 17 years and currently have ADHD by parent report, NS-CSHCN, 2009-2010

Characteristics	Race/Ethnicity % or mean (SE)				
	Total (N=4,606)	Non-Hispanic White (ref.) (n=3,454)	Non-Hispanic Black (n=399)	Hispanic (n=363)	Other (n=390)
Treatment					
Any medication (recommended)	74.2	77.1	63.5***	73.7	66.2*
Any behavioral therapy	39.0	37.2	46.1*	39.4	44.2
Any medication or behavioral therapy	85.5	86.8	82.3	84.9	79.4
Both medication and behavioral therapy (preferred)	27.7	27.4	27.3	28.2	31.0
Female	31.4	29.8	33.9	37.0	34.3
Mean age (y) (SE)	14.4 (0.04)	14.4 (0.05)	14.4 (0.14)	14.5 (0.17)	14.5 (0.13)
Region					
West	16.9	15.7	6.3***	35.0***	22.6
Midwest	26.4	28.8	24.7	13.3***	26.7
South	41.9	39.7	65.4***	35.4	27.4**
Northeast	17.6	18.4	10.9**	16.5	24.1
Highest education of a resident parent					
Less than high school	11.9	8.5	20.9***	23.2*	12.2
High school graduate	21.4	220.6	27.6	22.2	15.5
More than high school	66.7	70.9	51.4***	54.7**	72.3

Table 4 (continued)

Language spoken at home					
Other than English	2.9	0.2	0.3	24.1***	2.3
Family structure					
Two parents	61.4	70.1	28.2***	53.1**	48.4***
Single mother	29.2	22.1	56.4***	33.0*	43.9***
Other	9.4	7.9	15.4***	13.1	7.7
Number of CSHCN in household					
More than one	36.9	36.7	37.0	39.5	34.5
% Federal poverty level					
<100%	22.0	15.9	40.1***	33.9***	30.4***
100%-199%	21.4	18.5	31.5**	30.2*	17.8
200%-399%	30.2	19.0	17.3***	17.6***	26.5
≥400%	29.5	35.4	9.4***	18.3***	25.3*
Type of insurance					
Any private	57.0	64.6	33.8***	40.8***	50.4**
Public insurance (no private insurance)	36.5	28.5	60.8***	53.4***	44.8***
Other	3.6	4.2	1.6**	3.0	2.6
Uninsured	2.9	2.8	3.8*	2.8	2.1

Table 4 (continued)

Medical Home					
Has a medical home	39.8	44.6	23.9***	29.4***	38.3
USOC but no medical home	50.3	47.6	59.2**	59.9*	46.7
No USOC and medical home	9.8	7.9	16.9**	10.7	15.0*
Parent-perceived ADHD severity					
Mild	36.6	35.6	43.1	34.5	37.2
Moderate	45.4	47.2	36.8**	45.5	43.1
Severe	18.0	17.2	20.1	19.9	19.7
Comorbidity					
Depression	25.9	23.1	34.4**	32.0	28.3
Anxiety problems	64.6	23.7	50.4***	33.6	30.9
Behavioral or conduct problems	28.8	26.4	43.0***	30.4	28.3
ASD	8.9	10.0	5.7*	4.9**	10.6
Developmental delay	19.0	18.3	22.9	16.6	22.8
Intellectual disability or mental retardation	7.0	6.2	11.7*	5.6	9.3
Asthma	21.5	18.9	33.0***	23.6	21.9
Migraines or frequency headaches	16.1	14.9	20.1	14.6	23.1
Allergies	41.2	39.2	51.3**	40.4	44.1
Any other physical comorbidities [a]	12.9	11.5	13.6	16.2	21.0*

* $p<0.05$ ** $p<0.01$ *** $p<0.001$

[a] Other physical comorbidities includes diabetes, epilepsy or seizure disorder, head injury, concussion, or traumatic brain injury, heart problem, blood problems cystic fibrosis, cerebral palsy, muscular dystrophy, Down syndrome, and arthritis or joint problems

Multivariate Results: Children Aged 6-11 Years

The AAP guidelines recommend that for children who are 6-11 years of age, medications and/or behavioral therapy can be used as treatment for ADHD, and a combination therapy of both medication and behavioral therapy is preferred.[13] Multivariate results adjusting for predisposing characteristics, socioeconomic status, region, and comorbidities indicated that non-Hispanic black children (Marginal effect (ME)=-0.050 percentage points; SE=0.02) and children from other racial/ethnic groups (ME=-0.070 percentage points; SE=0.02) were significantly less likely than non-Hispanic white children to receive guideline-concordant treatment (any medication or behavioral therapy) for their ADHD (Table 5, Model 1). The findings remained statistically significant after including USOCs and medical homes, language spoken at home, and parent-perceived severity of ADHD (Table 5, Model 2, Model 3, and Model 4). The marginal effects remained similar in size across the first three model specifications; however, the negative association for non-Hispanic black children was slightly attenuated after adding parent-perceived severity of ADHD in the fourth regression model. Hispanic children did not significantly differ from non-Hispanic whites in their likelihood of receiving any ADHD treatments.

Having a medical home (versus having neither a USOC nor a medical home) and parent-perceived moderate and severe ADHD (versus parent-perceived mild ADHD) were positively associated with the receipt of any medication and behavioral therapy among children aged 6-11 years ($p<0.05$).

Multivariate analyses showed no racial/ethnic differences in the receipt of preferred treatment, both medication and behavioral therapy, among children aged 6-11

years (Table 6). The results were similar using a sample restricted to elementary school-aged children who received medication in the past week (data not shown). Having a USOC (versus having neither a USOC nor a medical home) and parent-perceived moderate and severe ADHD (versus parent-perceived mild ADHD) were positively associated with the receipt of preferred treatment ($p<0.01$).

Table 5. Weighted logistic regressions for racial/ethnic differences in the receipt of any medication or behavioral therapy (recommended treatment) among children aged 6-11 years

	Marginal effect (SE)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Race/ethnicity [a]				
Non-Hispanic black	-0.050*	-0.048*	-0.050*	-0.044*
	(0.02)	(0.02)	(0.02)	(0.02)
Hispanics	-0.001	0.006	0.024	0.029
	(0.02)	(0.02)	(0.02)	(0.02)
Other	-0.071***	-0.067**	-0.066**	-0.067**
	(0.02)	(0.02)	(0.02)	(0.02)
USOC and medical home [b]				
Has USOC but no medical home		0.038	0.037	0.030
		(0.02)	(0.02)	(0.02)
Has a medical home		0.062*	0.061*	0.061*
		(0.02)	(0.03)	(0.03)
Language spoken at home				
Other than English			-0.070	-0.072
			(0.04)	(0.04)
Parent-perceived severity [c]				
Moderate				0.079***
				(0.02)
Severe				0.068**
				(0.02)
Intercept	0.921***	0.919***	0.916***	0.914***
	(0.01)	(0.01)	(0.01)	(0.01)

Note: N=3937. All models control for age, gender, region, parent's education, family structure, number of CSHCN in household, household income, insurance, and comorbidities

[a] Non-Hispanic white omitted

[b] No USOC and no medical home omitted

[c] Mild Omitted

* p<0.05 ** P<0.01 *** p<0.001

Table 6. Weighted logistic regressions for racial/ethnic differences in the receipt of both medication and behavioral therapy (preferred treatment) among children aged 6-11 years

	Marginal effect (SE)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Race/ethnicity [a]				
Non-Hispanic black	0.033	0.033	0.033	0.040
	(0.04)	(0.04)	(0.04)	(0.04)
Hispanics	0.036	0.031	0.013	0.016
	(0.04)	(0.04)	(0.04)	(0.04)
Other	-0.068	-0.069	-0.072	-0.066
	(0.05)	(0.05)	(0.05)	(0.05)
USOC and medical home [b]				
Has USOC but no medical home		0.140**	0.143**	0.128**
		(0.05)	(0.05)	(0.05)
Has a medical home		0.089	0.092	0.087
		(0.05)	(0.05)	(0.05)
Language spoken at home				
Other than English			0.101	0.103
			(0.10)	(0.10)
Parent-perceived severity [c]				
Moderate				0.126***
				(0.03)
Severe				0.183***
				(0.03)
Intercept	0.340***	0.341***	0.343***	0.341***
	(0.01)	(0.01)	(0.02)	(0.01)

Note: N=3937. All models control for age, gender, region, parent's education, family structure, number of CSHCN in household, household income, insurance, and comorbidities

[a] Non-Hispanic white omitted

[b] No USOC and no medical home omitted

[c] Mild Omitted

* p<0.05 ** P<0.01 *** p<0.001

Multivariate Results: Children Aged 12-17 Years

For adolescents aged 12-17 years, medication is recommended for ADHD treatment, and a combination of medication and behavioral therapy is preferred according to the AAP guidelines.[13] Non-Hispanic blacks (ME=-0.106; SE=0.03) and other racial/ethnic groups (ME=-0.079; SE=0.004) were significantly less likely to receive any medication than non-Hispanic whites (Table 7, Model 1). The inclusion of USOCs and medical homes and parent-perceived severity of ADHD partially accounted for the differences between non-Hispanic blacks and non-Hispanic whites. Nevertheless, the negative association for Non-Hispanic blacks remained significant across all four model specifications.

Having a medical home (versus having neither a USOC nor a medical home) and parent-perceived moderate and severe ADHD (parent-perceived mild ADHD) were positively associated with the receipt of recommended treatment among children aged 12-17 years ($p<0.001$).

There were no racial/ethnic differences in the receipt of preferred treatment (Table 8), even using a restricted sample of adolescents who received any medication in the past week (data not shown).

Table 7. Weighted logistic regressions for racial/ethnic differences in the receipt of any medication (recommended treatment) among children aged 12-17 years

	Marginal effect (SE)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Race/ethnicity [a]				
Non-Hispanic black	-0.106***	-0.093**	-0.093**	-0.067*
	(0.03)	(0.03)	(0.03)	(0.03)
Hispanics	-0.009	-0.003	0.009	0.018
	(0.04)	(0.04)	(0.04)	(0.04)
Other	-0.079*	-0.073*	-0.072	-0.064
	(0.04)	(0.04)	(0.04)	(0.04)
USOC and medical home [b]				
Has USOC but no medical home		0.061	0.062	0.054
		(0.04)	(0.04)	(0.04)
Has a medical home		0.134***	0.134***	0.127***
		(0.04)	(0.04)	(0.04)
Language spoken at home				
Other than English			-0.053	-0.065
			(0.08)	(0.08)
Parent-perceived severity [c]				
Moderate				0.132***
				(0.02)
Severe				0.298***
				(0.04)
Intercept	0.765***	0.762***	0.760***	0.755***
	(0.01)	(0.01)	(0.01)	(0.01)

Note: N=4,606. All models control for age, gender, region, parent's education, family structure, number of CSHCN in household, household income, insurance, and comorbidities

[a] Non-Hispanic white omitted

[b] No USOC and no medical home omitted

[c] Mild Omitted

* p<0.05 ** P<0.01 *** p<0.001

Table 8. Weighted logistic regressions for racial/ethnic differences in the receipt of both medication and behavioral therapy (preferred treatment) among children aged 12-17 years

	Marginal effect (SE)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Race/ethnicity [a]				
Non-Hispanic black	-0.021	-0.025	-0.025	-0.002
	(0.04)	(0.04)	(0.04)	(0.04)
Hispanics	-0.011	-0.013	-0.031	-0.021
	(0.04)	(0.04)	(0.04)	(0.04)
Other	0.0004	0.001	-0.0004	0.008
	(0.04)	(0.04)	(0.04)	(0.04)
USOC and medical home [b]				
Has USOC but no medical home		0.019	0.018	0.013
		(0.04)	(0.04)	(0.04)
Has a medical home		-0.025	-0.026	-0.030
		(0.04)	(0.04)	(0.04)
Language spoken at home				
Other than English			0.067	0.060
			(0.09)	(0.08)
Parent-perceived severity [c]				
Moderate				0.134***
				(0.02)
Severe				0.228***
				(0.03)
Intercept	0.281***	0.282***	0.284***	0.279***
	(0.01)	(0.01)	(0.01)	(0.01)

Note: N=4,606. All models control for age, gender, region, parent's education, family structure, number of CSHCN in household, household income, insurance, and comorbidities

[a] Non-Hispanic white omitted

[b] No USOC and no medical home omitted

[c] Mild Omitted

* p<0.05 ** P<0.01 *** p<0.001

DISCUSSION

Key Findings

Among children aged 6-11 years, Non-Hispanic blacks and other racial/ethnic groups were significantly less likely than non-Hispanic whites to receive recommended treatment (i.e., medication treatment and/or behavioral therapy) for their disorders. The inclusion of USOCs and medical homes, language spoken at home, and parent-perceived severity of ADHD did little to explain these racial/ethnic differences. This suggests that other factors may be largely responsible for these differences. The unmeasured differences in stigma and attitude toward MH issues could explain a portion of the lower rates of recommended treatment use among non-Hispanic blacks and children of other racial/ethnic groups.[41,43] In addition, since there were significant differences in regions of residence by racial/ethnic groups, the unmeasured health care provider supply and the density of MH professionals may also explain the racial/ethnic differences in the receipt of recommended treatment.

Among children aged 12 – 17 years, Non-Hispanic blacks and other racial/ethnic groups were significantly less likely to receive recommended treatment (i.e. medication) relative to non-Hispanic whites. In this age group, differential access to a USOC and a medical home accounted for part of the differences in the receipt of any medication for non-Hispanic blacks aged 12-17. This result confirms previous findings that minority children used less MH services due to lower likelihood of having a USOC or a medical home.[63]

The inclusion of parent-perceived severity of ADHD also partially accounted for the differences in recommended treatment for non-Hispanic blacks aged 12-17 years. As

shown by descriptive analyses, parents of non-Hispanic black children were more likely to report milder symptoms of their children's ADHD compared to non-Hispanic whites. These findings indicate that the factors related to parent health beliefs, such as cultural and ethnic affiliations, education level, and occupation may explain the lower treatment rates among non-Hispanic black children. This would be consistent with findings in other studies indicating that parent attitude toward and involvement in children's MH treatment are influenced by cultural and socioeconomic status, and children largely depend on their parent's recognition to identify their MH needs and to seek appropriate services.[41,68,74] .

Unlike previous studies, this study did not find any significant differences in the receipt of guideline-concordant treatment between Hispanic children and non-Hispanic white children. One possible reason is that the analytic sample only includes children whose parents reported that their children had received an ADHD diagnosis by a health care professional and had current ADHD. Influenced by cultural and religious factors, Hispanic parents may be more likely than non-Hispanic white parents to misinterpret the symptoms of ADHD and may be less likely to report their children's ADHD.[43,68] Hispanic children may also be less likely to access the health care and mental health care system, which may affect their likelihood of being diagnosed with ADHD by a health care provider.[25,29,63] Another reason may be the relatively small number of Hispanic children who speak another language other than English at home of both age groups in our sample. Studies have revealed that non-English speaking children were less likely to use MH services, controlling for sociodemographic and clinical factors.[44,53] As descriptive analysis has shown, there were distinct differences in primary household language between Hispanic children and non-Hispanic white children. Therefore, the

limited number of Hispanic children who did not speak English at home in this sample may conceal the racial/ethnic differences in guideline-treatment use for ADHD in the population.

For both aged groups, having a medical home was positively associated with receiving recommended treatment for ADHD. Prior research has reported that access to a medical home has a positive association with the reduction of unmet MH care needs for both black children and white children.[25] Consequently, future research should assess whether improving access to a medical home is a strategy to reduce racial/ethnic disparities in the receipt of guideline-concordant ADHD treatment among children.

Limitations

This study has several limitations. First, causality in the relationship between use of guideline-concordant treatments and race/ethnicity cannot be established because the data are cross-sectional. Second, the measures of the presence of ADHD and guideline-concordant treatment utilization rely on parents' self-reported information. Recall bias could influence results. Additionally, parents' stigma and negative attitudes toward ADHD and ADHD treatment could also affect the findings. Minority parents may be more likely to conceal their children's MH status and service utilization.

Another limitation is unmeasured community-level constructs (i.e., supply of health care providers). The variable measuring medical home status, however, may be correlated with the availability of health care providers. Moreover, this study may have been limited in its ability to assess whether primary household language explains any of

the relationship between race/ethnicity and the receipt of ADHD treatment due to the small sample size of children who do not speak English at home.

Future Research

Future research would benefit from the use of data that have oversampled minority populations and contain more objective information on ADHD diagnosis. It would also be informative to use qualitative methods to investigate parent-perceived barriers to receiving ADHD treatment, which would be helpful for understanding the cultural reasons why minority youth are more likely to have unmet MH needs. Future studies examining the extent to which the density of MH professionals in community-, state-, and region-level explain racial/ethnic differences in ADHD would also be informative. This would help to reveal the scarcity and unbalance of health care resources for minority children so that policy makers could reallocate health care resources to improve health status of minority children. Finally, future research should examine the effects of comorbidity, especially MH comorbid conditions, on the relationship between race/ethnicity and the receipt of ADHD treatment.

Conclusions

This study is the first to examine racial/ethnic differences in guideline-concordant treatment for ADHD among children using a national database. We found racial/ethnic differences in the receipt of guideline-concordant treatment among children aged 6-17 years with current ADHD. Moreover, USOCs, medical homes, and parent-perceived of severity of children's symptoms were identified as factors that partially explain the

differences in the receipt of guideline-concordant treatment for ADHD. Future studies should seek to use appropriate data to examine other cultural and system-level pathways that could explain racial/ethnic differences in the receipt of ADHD treatment.

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APPENDICES

Table 9. Weighted logistic regressions for racial/ethnic differences in the receipt of any medication among children aged 6-11 years

	Marginal effect (SE)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Race/ethnicity [a]				
Non-Hispanic black	-0.061	-0.057	-0.058	-0.044
	(0.03)	(0.03)	(0.03)	(0.03)
Hispanics	-0.040	-0.026	-0.010	-0.004
	(0.03)	(0.03)	(0.04)	(0.04)
Other	-0.159***	-0.152***	-0.151***	-0.146***
	(0.03)	(0.03)	(0.03)	(0.03)
USOC and medical home [b]				
Has USOC but no medical home		0.049	0.047	0.033
		(0.03)	(0.03)	(0.03)
Has a medical home		0.122***	0.120***	0.121***
		(0.03)	(0.04)	(0.03)
Language spoken at home				
Other than English			-0.087	-0.091
			(0.07)	(0.07)
Parent-perceived severity [c]				
Moderate				0.128***
				(0.02)
Severe				0.187***
				(0.03)
Intercept	0.811***	0.807***	0.804***	0.800***
	(0.01)	(0.01)	(0.01)	(0.01)

Note: N=3937. All models control for age, gender, region, parent's education, family structure, number of CSHCN in household, household income, insurance, and comorbidities

[a] Non-Hispanic white omitted

[b] No USOC and no medical home omitted

[c] Mild Omitted

* p<0.05 ** P<0.01 *** p<0.001

Table 10. Weighted logistic regressions for racial/ethnic differences in the receipt of any behavioral therapy among children aged 6-11 years

	Marginal effect (SE)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Race/ethnicity [a]				
Non-Hispanic black	0.041	0.037	0.037	0.041
	(0.04)	(0.04)	(0.04)	(0.04)
Hispanics	0.084	0.070	0.052	0.055
	(0.05)	(0.04)	(0.05)	(0.05)
Other	0.032	0.024	0.021	0.025
	(0.06)	(0.06)	(0.06)	(0.06)
USOC and medical home [b]				
Has USOC but no medical home		0.133**	0.137**	0.131**
		(0.05)	(0.05)	(0.05)
Has a medical home		0.035	0.038	0.036
		(0.05)	(0.05)	(0.05)
Language spoken at home				
Other than English			0.101	0.105
			(0.10)	(0.10)
Parent-perceived severity [c]				
Moderate				0.066*
				(0.03)
Severe				0.062
				(0.04)
Intercept	0.450***	0.453***	0.455***	0.454***
	(0.01)	(0.01)	(0.02)	(0.02)

Note: N=3937. All models control for age, gender, region, parent's education, family structure, number of CSHCN in household, household income, insurance, and comorbidities

[a] Non-Hispanic white omitted

[b] No USOC and no medical home omitted

[c] Mild Omitted

* p<0.05 ** P<0.01 *** p<0.001

Table 11. Weighted logistic regressions for racial/ethnic differences in the receipt of any behavioral therapy among children aged 12-17 years

	Marginal effect (SE)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Race/ethnicity [a]				
Non-Hispanic black	0.049	0.039	0.039	0.055
	(0.04)	(0.04)	(0.04)	(0.04)
Hispanics	-0.008	-0.014	-0.026	-0.021
	(0.04)	(0.04)	(0.04)	(0.04)
Other	0.013	0.013	0.012	0.017
	(0.04)	(0.04)	(0.04)	(0.04)
USOC and medical home [b]				
Has USOC but no medical home		0.031	0.030	0.025
		(0.04)	(0.04)	(0.04)
Has a medical home		-0.062	-0.063	-0.067
		(0.04)	(0.04)	(0.04)
Language spoken at home				
Other than English			0.050	0.048
			(0.09)	(0.09)
Parent-perceived severity [c]				
Moderate				0.085***
				(0.02)
Severe				0.137***
				(0.04)
Intercept	0.384***	0.386***	0.387***	0.384***
	(0.01)	(0.01)	(0.01)	(0.01)

Note: N=4,606. All models control for age, gender, region, parent's education, family structure, number of CSHCN in household, household income, insurance, and comorbidities

[a] Non-Hispanic white omitted

[b] No USOC and no medical home omitted

[c] Mild Omitted

* p<0.05 ** P<0.01 *** p<0.001

Table 12. Weighted logistic regressions for racial/ethnic differences in the receipt of any medication or behavioral therapy among children aged 12-17 years

	Marginal effect (SE)			
	Model 1	**Model 2**	**Model 3**	**Model 4**
Race/ethnicity [a]				
Non-Hispanic black	-0.041	-0.032	-0.032	-0.011
	(0.03)	(0.03)	(0.03)	(0.03)
Hispanics	-0.007	-0.004	0.013	0.016
	(0.03)	(0.03)	(0.03)	(0.03)
Other	-0.062*	-0.055	-0.054	-0.048
	(0.03)	(0.03)	(0.03)	(0.03)
USOC and medical home [b]				
Has USOC but no medical home		0.066*	0.068*	0.061*
		(0.03)	(0.03)	(0.03)
Has a medical home		0.085**	0.086**	0.079**
		(0.03)	(0.03)	(0.03)
Language spoken at home				
Other than English			-0.067	-0.074
			(0.06)	(0.07)
Parent-perceived severity [c]				
Moderate				0.094***
				(0.02)
Severe				0.219***
				(0.04)
Intercept	0.867***	0.865***	0.863***	0.859***
	(0.01)	(0.01)	(0.01)	(0.01)

Note: N=4,606. All models control for age, gender, region, parent's education, family structure, number of CSHCN in household, household income, insurance, and comorbidities

[a] Non-Hispanic white omitted

[b] No USOC and no medical home omitted

[c] Mild Omitted

* p<0.05 ** P<0.01 *** p<0.001