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Racial/Ethnic Disparities in ADHD Diagnosis by Kindergarten Entry

Paul L. Morgan[1], **Marianne M. Hillemeier**[2], **George Farkas**[3], and **Steve Maczuga**[4]

[1]The Pennsylvania State University, Educational Psychology, Counseling, and Special Education University Park, Pennsylvania, United States

[2]The Pennsylvania State University, Health Policy and Management, Pennsylvania, United States

[3]University of California, Irvine, Education, California, United States

[4]The Pennsylvania State University, Population Research Institute, University Park, Pennsylvania, United States

Abstract

Background—Whether and to what extent racial/ethnic disparities in Attention-Deficit/Hyperactivity Disorder (ADHD) diagnosis occur by kindergarten entry is currently unknown. We investigated risk factors associated with an ADHD diagnosis by kindergarten entry generally, and specifically whether racial/ethnic disparities in ADHD diagnosis occur by this very early time period.

Methods—Secondary analysis of data from children enrolled in the Early Childhood Longitudinal Study-Birth Cohort (ECLS-B), a large, nationally representative cohort of U.S. children born in 2001. Data include information from birth certificates, parent and teacher questionnaires, and in-person developmental assessments conducted with children at intervals from birth through kindergarten entry. The analytic sample included children enrolled in the ECLS-B at the 60-month assessment (*N*=6,550).

Results—Black children in the U.S. were 70% (1 - *OR* of .30) less likely to receive an ADHD diagnosis than otherwise similar White children. Hispanic children initially appeared to be under-diagnosed for ADHD. However, their disparity with Whites became statistically nonsignificant after controlling for whether a language other than English was primarily spoken in the home. Analyses of kindergarten teacher-reported classroom behavior indicated that neither Black nor Hispanic children displayed less frequent ADHD-related behaviors than Whites.

Conclusions—Although they are not less likely to display ADHD-related behaviors, children who are Black or being raised in households where non-English is primarily spoken are less likely than otherwise similar White children to be diagnosed with ADHD in the U.S.

Correspondence: Paul L. Morgan, 330 CEDAR Building, Department of Educational Psychology, Counseling, and Special Education, The Pennsylvania State University, University Park, PA 16802; paulmorgan@psu.edu.

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Keywords

ADHD; racial/ethnic minorities; disparities; diagnosis; preschool

ADHD is a chronic condition that may require pharmacological treatment as early as age 4 (American Academy of Pediatrics, 2011). Early treatment can result in changes in ADHD's pathogenesis (Berger & Nevo, 2011; McGoey, Eckert, & Dupaul, 2002; Murray, 2010), thereby attenuating the typical developmental sequelae (Sonuga-Barke & Halperin, 2010) of lower academic achievement and socio-emotional maladjustment (Barbaresi et al., 2013; Galéra, Melchior, Chastang, Bouvard, & Fombonne, 2009).

Racial/Ethnic Disparities in ADHD Diagnosis

Not all racial/ethnic population subgroups in the U.S. may be equally likely to be diagnosed and so treated for ADHD

School-aged racial/ethnic minority children in particular may be less likely to receive an ADHD diagnosis than otherwise similar Whites and so have unmet treatment needs (Mehta, Nagar, & Aparasu, 2009; Schneider & Eisenberg, 2006). A recent review (Miller, Nigg, & Miller, 2009) indicated that Black children are diagnosed with ADHD at two-thirds the rate of White children despite displaying greater symptomology. Hispanics and other racial/ethnic groups are also less likely to receive an ADHD diagnosis (Blumberg, Read, Avila, & Bethell, 2010; Pastor & Reuben, 2008), although less is known about these other groups (Guevara et al., 2005). Hypothesized mechanisms for disparities in ADHD diagnosis include (a) lower access by minority families to health professionals (Coker et al., 2009) and, when seen, fewer solicitations by professionals of developmental concerns (Guerrero, Rodriguez, & Flores, 2011), (b) more limited ability to pay for health care, (c) non-English language use, and (d) negative views towards disability and related stigma (Hervey-Jumper, Douyon, Falcone, & Franco, 2008; Olaniyan et al., 2007).

However, and although racial/ethnic disparities in ADHD diagnosis have been found in older school-aged populations (Miller et al., 2009; Pastor & Reuben, 2008), whether these disparities occur as early as kindergarten is unknown, as is the degree to which these disparities are explained by socio-demographic, gestational, birth, parenting, home environment, and additional risk factors (Miller et al.; Samuel et al., 1997). Racial/ethnic disparities in ADHD in very young children have yet to be investigated in large-scale, longitudinal samples (Bailey et al., 2010). Existing ADHD research is mostly based on clinic-referred samples (e.g., Barnow, Schuckit, Smith, & Freyberger, 2006; Biederman, Petty, Evans, Small, & Faraone, 2010; Hervey-Jumper, Douyon, & Franco, 2006), which typically are disproportionately White and over-represent males and those with more severe symptoms (Brassett-Harknett & Butler, 2007). Very few studies have analyzed population-based or nationally representative samples (Sauver et al., 2004; Sciberras, Ukoumunne, & Efron, 2011), and have often used cross-sectional designs (Cuffe, Moore, & McKeown, 2005), analyzed later time periods (e.g., diagnosis by 3rd grade) (Schneider & Eisenberg, 2006), or analyzed non-U.S. samples (Galéra et al., 2011).

Establishing that racial/ethnic disparities in ADHD diagnosis occur by kindergarten entry in the U.S. would suggest the need for greater culturally and linguistically sensitive screening efforts at early ages to ensure that racial/ethnic minority children are appropriately diagnosed and treated (Morgan, Staff, Hillemeier, Farkas, & Maczuga, 2013). Failure to appropriately treat young minority children with ADHD may at least partially explain large, long-standing racial/ethnic achievement gaps (Basch, 2011).

However, accurate estimates of racial/ethnic disparities in ADHD diagnosis in the U.S. requires control for potential confounding factors, including socio-demographic, perinatal, and birth characteristics, parenting and family conditions, and children's early behavioral and cognitive functioning (Berger & Nevo, 2011). For example, minority children are at higher risk of low birthweight, which can result in impaired executive functioning (Anderson, 2003). Labor complications, as well as maternal smoking and substance abuse, may also impact early brain development and result in less inhibitory control (Galéra et al., 2011). Minority children are more likely to live in households with low maternal education, low income, and single parenthood (Breslau & Chilcoat, 2000), and to experience extreme disadvantage (US Census Bureau, 2012), which increases the risk of ADHD (Claycomb et al., 2004). This may in part result in increased maternal stress during and following pregnancy that then affects early brain development (Claycomb, Ryan, Miller, & Schnakenberg-Ott, 2004; Van den Bergh & Marcoen, 2004). Young children with ADHD are also more likely to be raised by mothers displaying psychopathology (Chronis et al., 2003), whose maladaptive parenting may exacerbate their children's ADHD symptomatology (Deault, 2010).

Study's Purpose

We investigated whether and to what extent racial/ethnic minority disparities in ADHD diagnosis occur by kindergarten entry in the U.S. To accurately identify risk factors for diagnosis by age five, and to estimate the magnitude of any observed disparities among *otherwise similar* children, we controlled for many additional background characteristics at 24 months. We also examined whether population subgroups at greater or lesser risk of receiving an ADHD diagnosis were more or less likely to display ADHD behavioral risk indicators (e.g., inattention, impulsivity). This research extends prior work by (a) examining whether racial/ethnic disparities are already evident by kindergarten entry, (b) analyzing a heterogeneous, large-scale, nationally representative, and longitudinal dataset, and (c) accounting for many potential confounds, thereby providing rigorously derived estimates for a wide range of factors that might predict 24-month-old children's receipt of an ADHD diagnosis by 60 months of age.

Method

Database and Analytical Sample

The ECLS-B is a longitudinal cohort study representative of U.S. children born in 2001. The dataset includes birth certificate information, as well as parent interviews and direct assessments of children's cognitive, academic, behavioral, and physical functioning at 9, 24, 48, and 60 months of age. The analytical sub-sample (N = 6,550) included children with and

without an ADHD diagnosis at 60 months. (All reported sample sizes were rounded to the nearest 50 to comply with National Center for Education Statistics participant confidentiality requirements.) Missing data on predictor variables were multiply imputed with the IVEWARE SAS add-on (Raghunathan, Solenberger, & Van Hoewyk, 2002). Penn State's IRB provided ethical approval for the analyses.

Measures

ADHD Diagnosis—At 60 months, NCES field staff asked parents: “Since (child) turned 4 years old, has a doctor has ever told you that your child has the following condition?…Does (he/she) have ADHD?” About 150 children in the analysis sample had an ADHD diagnosis. Parents are reported to be valid and reliable reporters on ADHD diagnosis, symptoms, receipt of treatment, and pharmacological dosage response (Biederman, Faraone, Milberger, & Doyle, 1993; Biederman, Faraone, Monuteaux, & Grossbard, 2004; Biederman, Gao, Rogers, & Spencer, 2006; Bussing, Mason, Leon, & Sinha, 2003).

ADHD medication use—Parents were asked whether their child had taken prescription medication every day for at least three months. If they answered “yes,” parents were then asked why the child had to take this medicine, with “ADHD” as one response option. Among those with ADHD, the following percentages of children were taking ADHD-related medication: 40% of Whites; 30% of Blacks; and 20% of Hispanics. However, we observed no statistically significant differences in medication use between these groups of children.

Socio-demographic characteristics—Children's race/ethnicity was parent-reported, and non-Hispanic Whites were compared to non-Hispanic Blacks, Hispanics, and other races/ethnicities. Child age in months was included to account for variation in age at assessment. The socioeconomic status (SES) measure was a composite of father's education, mother's education, father's occupation, mother's occupation, and household income. The SES distribution was divided into quintiles. Mother's age at child's birth (35 years or older vs. under 35 years) was included, as was mother's marital status at 24 months.

Gestational and birth characteristics—Birthweight was indicated by dichotomous variables for very low birthweight (≤1500 grams) and moderately low birthweight (1,501-2,500 grams), contrasted with birthweight >2,500 grams. Count variables reflected several sets of risk factors: obstetrical procedures (induction of labor, stimulation of labor, tocolysis, amniocentesis, and cesarean section); labor complications (abruptio placenta, anesthetic complications, dysfunctional labor, breech/malpresentation, cephalopelvic disproportion, cord prolapsed, fetal distress, excessive bleeding, fever of > 100°F, moderate/heavy meconium, precipitous labor (< 3 h), prolonged labor (> 24 h), placental previa, or seizures during labor); medical risk factors during pregnancy (incompetent cervix, acute or chronic lung disease, chronic hypertension, pregnancy-induced hypertension, eclampsia, diabetes, hemoglobinopathy, cardiac disease, anemia, renal disease, genital herpes, oligohydramnios, uterine bleeding, Rh sensitization, previous birth weighing 4,000+g, or previous preterm birth); and behavioral risk factors during pregnancy (maternal alcohol and/or tobacco use).

Vocabulary knowledge—A modified version of the MacArthur Communication Development Inventory (M-CDI) (Fenson et al., 1994) was administered at 24 months, surveying words typically known and said by children at that age. The total number of words children were reported to say was analyzed as a continuous variable. The M-CDI vocabulary scales have high internal consistency (*a*=.96) and are highly correlated with other standardized measures (Fenson, Dale, Reznick, Thal, & Bates, 1993).

Cognitive functioning—Cognitive functioning was evaluated using the Bayley Short Form-Research Edition (BSF-R), an extensively psychometrically-validated (see Andreassen, Fletcher, & Park, 2007) modified version of the Bayley Scales of Infant Development, 2nd Edition (BSID-II) (Bayley, 1993). The BSF-R mental scale measures age-appropriate cognitive functioning as manifested in memory, habituation, preverbal communication, problem-solving and concept attainment.

Learning-related behaviors—The Behavior Rating Scale-Research Edition (BRS-R) assessed children's behavioral self-regulation. Adapted from the Behavior Rating Scale (BRS) (Bayley, 1993), the BRS-R included 11 interviewer-rated items (e.g., 1="*constantly off task, does not attend*," 5="*constantly attends*") of behaviors at 24 months (Nord, Edwards, Andreassen, Green, & Wallner-Allen, 2006) including attention to task, persistence, cooperation with an examiner, and interest in the testing materials, observed while administering the BSF-R cognitive and physical tasks. The behaviors were each rated on a 5-point scale (low=1; high=5). Seven items were used as autoregressive behavioral controls in the analyses.

Home environment quality—A modified version of the Home Observation for Measurement of the Environment (HOME; Caldwell & Bradley, 1984) measured home environment and parenting quality. The HOME score is a count of 15 items measuring (a) parental activities including reading to the child, telling stories, singing, and taking the child on errands or to public places; (b) having toys, records, books, and audiotapes available in the home; and (c) having a safe and supportive home environment.

Parenting quality—Parenting quality was measured based on videotaped interactions during the Two Bags Task. Parents were first asked to interact with their child over a children's picture book, then interact with a set of toy dishes. A composite parent support variable indexed three types of parent interactions: parental sensitivity, stimulation of cognitive development, and positive regard. Mean inter-rater reliability for the parent rating scales was 97%, with mean reliabilities of 97%, 93%, and 94% for sensitivity, cognitive stimulation, and positive regard, respectively (Andreassen et al., 2007).

Parental or family history of mental illness—Parents were asked whether they or a blood relative ever had "a serious mental illness, such as schizophrenia, a paranoid disorder, a bipolar disorder, or manic episodes."

Limited access to health insurance—Parents reported whether their children had no health insurance, had experienced gaps in insurance coverage, or had a need for health care and could not obtain it.

Non-English as primary language in the home—Parents reported whether English was the primary language spoken at home.

ADHD-related behaviors at 60 months—Kindergarten teachers reported on six behaviors relating to ADHD symptomology: (a) “child pays attention well”; (b) “child works independently”; (c) “child finishes tasks”; (d) “child is impulsive”; (e) “child is over active”; and (f) “child is fidgety.” Teachers rated frequency of specific behaviors (e.g., 1=*never shows this type of behavior*, 5=*very often shows this type of behavior*). We reverse-coded the last three items and summed the values so that higher values indicated more appropriate classroom behavior. Cronbach's alpha for this scale was .90. The bottom 9.2% (the closest to 10% permitted by the discrete values of the variable) of children were identified as displaying behavioral risk indicators of ADHD symptomology.

Data Analysis

We estimated (Table 2) logistic multiple regression models predicting the odds of ADHD diagnosis by 60 months, sequentially adding control variables. We also estimated (Table 3) logistic regressions predicting the odds that the kindergarten teacher rated the child as being in the bottom 9.2 % on a continuous scale of ADHD-related behavioral functioning. All regression analyses accounted for sampling weight and design effects to adjust for oversampling and the ECLS-B's stratified cluster design (i.e., WKICO and both Strata and PSU variables). The analyses used SAS version 9.2.

Results

Table 1 indicates that 2.4% received an ADHD diagnosis by 60 months. Model 1 in Table 2 shows that Black and Hispanic children have unadjusted odds of ADHD diagnosis substantially below those of Whites, although these estimates are not statistically significant. Adding behavioral indicators in Model 2, Black or Hispanic children have lower, statistically significant odds of ADHD diagnosis (*OR*s of .50 and .43, respectively) compared to otherwise similar White children. Task persistence is also a statistically significant and strong predictor of ADHD diagnosis at 60 months. Adding additional control variables in Model 3 further lowers the *OR* for Black children to .30. For Hispanics, the odds ratio increases to .58, which is still relatively low but no longer statistically significant. Task persistence is the only statistically significant 24-month behavior. Other variables lowering the odds of ADHD diagnosis are higher SES, non-singleton birth, and non-English primary language at home. Adding non-English use in the home to Model 3 helps explain Model 2's predictive relation between being Hispanic and a lower likelihood of being diagnosed with ADHD. Variables increasing the diagnosis rate include being male, the child's biological father not in household, and family history of mental illness.

Model 1 in Table 3 indicates that, although children who are Black have *lower* ADHD diagnosis rates than Whites, they have significantly *higher* likelihood of displaying ADHD symptomology. Black and Hispanic children's higher rates of ADHD symptomology are reduced to statistical non-significance in Model 2. These analyses help confirm that the lower rates of ADHD diagnosis observed for racial/ethnic minority children are not explained by comparatively lower rates of ADHD symptomology. Model 3 indicates that,

despite a large number of controls, ADHD diagnosis is positively and significantly related to ADHD-related behavioral functioning in kindergarten (*OR*=6.69), suggesting that parents accurately reported their child's ADHD diagnosis.

Discussion

This study contributes new knowledge in three ways. First, although older Black children have been reported to be less likely to be diagnosed for ADHD, no study to date has investigated whether these disparities are occurring as children begin to enter school in the U.S. Second, few studies have examined disparities among Hispanic children, who appear to have lower ADHD diagnosis rates than otherwise similar Whites. Third, our study addresses a number of serious methodological and substantive limitations in prior work, including frequent reliance on convenience samples that over-represent White children and those with more severe symptomology.

Possible Explanatory Mechanisms

Possible explanations for the observed racial/ethnic disparities include less willingness among minority parents to seek professional help for ADHD symptoms. Attitudes toward help seeking outside of the family are thought to differ among racial/ethnic groups, with some minority parents preferring to rely on extended families for support (García Coll et al., 1996). Black parents may also be reluctant to seek medical treatment for ADHD due to less favorable attitudes, including towards mental health illness generally (Leslie et al., 2003) and pharmacological treatment for ADHD specifically (Dosreis et al., 2003). For example, some Black parents report fearing that use of ADHD medication by their children may increase their risk for substance abuse (Dosreis et al.). Black and Hispanic parents may be more reluctant than White parents to make use of mental health services (McMiller & Weisz, 1996), although Hispanic parents have been reported to be as likely to utilize these services as White parents after controlling for English proficiency (Coker et al., 2009). Thus, a possible interpretation for our results is that Black parents are relatively more reluctant to obtain a mental health diagnosis for their children (OHara, 2003), while language barriers may explain Hispanic children's lower likelihood of diagnosis. Alternatively, it may be that clinicians are more reluctant to diagnose racial/ethnic minority children as having ADHD. Medical practitioners have been found to avoid identifying racial/ethnic minority children as having conditions necessitating treatment (Gerber et al., 2013) and minority children have been shown to receive diagnoses later than White children (Mandell et al., 2009). Health professionals have also been observed to engage in less collaborative decision-making with minority families whose children are diagnosed with ADHD (Brinkman et al., 2011).

Limitations

Reliance on parent response to identify children diagnosed with ADHD is a limitation of this study, although parents have repeatedly been found to be valid and reliable reporters on their children's ADHD symptomology, diagnosis, and treatment, as well as dosage response to pharmacological regimes (e.g., Biederman et al., 2004, 2006). Supplementary analyses (not shown) indicated good agreement between parental report of an ADHD diagnosis and independent teacher ratings of children's ADHD-related behavior. The extensive statistical

control used in our analyses helps ensure appropriate adjustment for potential confounding. However, it remains possible that non-invariant (given our statistical control for autoregressive ADHD-related behavioral functioning at 24 months) unmeasured variables may help account for the lower odds of ADHD diagnosis attributed to race/ethnicity. Consistent with other research (Braun et al., 2006; Miller et al., 2009), we interpret the directionality of the disparities as indicating under-diagnosis for children who are Black or Hispanic. Another possible interpretation is that children who are White are comparatively over-diagnosed. **It may also be that the observed disparities are not specific only to ADHD but also occur for other conditions.** An additional limitation is that our analyses are based on a sample of U.S. born children, which constrains the generalizability of the findings. The social milieu of the U.S. with regard to Blacks, Whites, and Hispanics is relatively unique. Nevertheless, the diagnosis patterns we report may also apply to comparatively disadvantaged children in other countries. For example, Black children in Great Britain have been reported to be much less likely to be diagnosed than White children for hyperkinetic disorders (Meltzer, Gatward, Goodman, & Ford, 2003). The paucity of disparities research on ADHD diagnosis across other countries and cultures warrants greater attention.

Implications

A practical implication of our study is the need for more clinicians to employ culturally and linguistically sensitive screening methods for the early onset of learning and behavior problems. Helping minority parents to recognize potential ADHD symptoms in their children, as well as encouraging help-seeking behaviors may help prevent or reduce racial/ethnic health disparities (Flores & Committee On Pediatric Research, 2010; Hillemeier, Foster, Heinrichs, & Heier, 2007). Our study suggests that service providers who make language services available to non-English-speaking parents during clinical visits may help reduce ADHD diagnosis disparities for Hispanic children.

Our results also indicate that young children most at risk for an ADHD diagnosis by kindergarten entry include males, those in low SES households or without a biological father at home, and those with a family history of mental illness. Another implication of our findings is that persistence at cognitively demanding tasks may constitute a unique, potentially malleable target for interventions to prevent or reduce later ADHD symptomology. Our findings in this regard are consistent with prior studies among older children reporting that relatively lower task persistence is a distinctive behavioral characteristic of ADHD (Balint et al., 2009; Hoza, Pelham, Waschbusch, Kipp, & Owens, 2001).

Conclusion

Young children in the U.S. who are Black, or who are Hispanic and speaking a language other than English in their homes, are comparatively under-diagnosed for ADHD by kindergarten entry. These disparities are not explained by an unusually extensive number of potential confounding factors. Increasing the availability of culturally and linguistically sensitive screenings to these two groups of children may be necessary, as they may have unmet treatment needs that may in turn contribute to later racial/ethnic achievement gaps

(Basch, 2011). Our results should better direct efforts to screen, monitor, and prevent or remediate ADHD for young children in the U.S. as they begin formal schooling, particularly racial/ethnic minorities.

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Key points

- Older, school-aged minority children are less likely than White children to receive an ADHD diagnosis in the U.S.
- These disparities may occur by kindergarten entry. Although not less likely to display ADHD symptomology, children who are Black or being raised in households where non-English is primarily spoken are less likely than otherwise similar White children to be diagnosed with ADHD in the U.S. by this early time period.
- Clinicians may need to help minority parents to recognize potential ADHD symptomology, encourage help-seeking behaviors, and adopt culturally and linguistically sensitive screening procedures to help reduce the early onset of ADHD diagnosis disparities for Black and Hispanic children in the U.S.

Table 1

Descriptive Statistics, Weighted (N = 6,550)[a].

	***M* (*SD*), 60 Months**
Race/ethnicity	
White	53.7%
Black	13.9%
Hispanic	25.1%
Other race/ethnicity	7.2%
Behavioral functioning (24 months)[b]	
Attentive	3.5 (1.0)
Persistent	3.4 (1.1)
Not frustrated	3.7 (1.0)
Cooperative	3.4 (1.1)
No negative affect	3.4 (1.3)
Adapts to change	3.6 (1.1)
Shows interest	3.5 (0.9)
Socio-demographics (24, 60 months)	
Age, 60 months	64.7 (3.8)
Male	51.2%
Lowest SES quintile, 24 months	19.9%
Second lowest SES quintile, 24 months	20.5%
Middle SES quintile, 24 months	20.5%
Second highest SES quintile, 24 months	19.8%
Highest SES quintile, 24 months	19.3%
Non-singleton	3.2%
Mother 35 years old or older at time of birth	13.9%
Mother not married, 24 months	32.4%
No biological father in household, 24 months	18.4%
Northeast	16.7%
Midwest	21.9%
South	37.0%
West	24.3%
Urban	73.4%
Suburban	11.1%
Rural	15.5%
Perinatal and birth conditions (0 months)	
Very low birth weight	1.3%
Moderately low birth weight	6.2%
Labor complications	28.4%
Obstetric procedures	47.6%
Medical risk factors at birth	15.2%
Behavioral risk factors at birth	11.0%

	***M* (*SD*), 60 Months**
Cognitive functioning (24 months)	
Number of words spoken	29.1 (12.0)
Bayley score	127.2 (10.8)
Family conditions (24 months)	
HOME score	10.0 (1.9)
Two Bags score	4.4 (0.9)
Limited health insurance coverage	10.2%
History of mental illness	10.5%
Non-English is primary language at home	19.1%
ADHD at kindergarten	2.4%

[a] All reported sample sizes were rounded to the nearest 50 to comply with National Center for Education Statistics participant confidentiality requirements

[b] Higher score is more appropriate behavior; SES=Socioeconomic status.

Table 2

Logistic Regression Models (Odds Ratios) of ADHD Diagnosis by 60 Month Assessment, 24-Month Predictors (N = 6,550)[a].

	Model 1	Model 2	Model 3
Race/ethnicity (vs. White)			
Black	0.72	0.50*	0.30**
Hispanic	0.58	0.43*	0.58
Other race/ethnicity	0.91	0.68	0.75
Behavioral functioning (24 months)[b]			
Attentive		0.74	0.87
Persistent		0.51**	0.51***
Not frustrated		0.93	0.96
Cooperative		1.02	0.98
No negative affect		1.04	1.05
Adapts to change		1.07	1.18
Shows interest		1.03	1.14
Socio-demographics (24, 60 months)			
Age, 60 months			1.04
Male			3.37***
Second lowest SES quintile, 24 months			1.39
Middle SES quintile, 24 months			0.61
Second highest SES quintile, 24 months			0.37*
Highest SES quintile, 24 months			0.27*
Non-singleton			0.53*
Mother 35 years old or older at time of birth			0.98
Mother not married, 24 months			0.69
No biological father in household, 24 months			2.18*
Midwest			2.01
South			2.20
West			1.02
Suburban			1.22
Rural			0.75
Perinatal and birth conditions			
Very low birth weight			1.60
Moderately low birth weight			1.24
Labor complications			1.32
Obstetric procedures			0.89
Medical risk factors at birth			1.43
Behavioral risk factors at birth			0.96
Cognitive functioning (24 months)			
Number of words spoken			0.72

	Model 1	Model 2	Model 3
Bayley score			0.90
Parenting quality (24 months)			
HOME score			0.86
Two Bags score			1.25
Family conditions (24 months)			
Mother or family member had mental illness			2.53**
Limited health insurance coverage			1.78
Non-English is primary language at home			0.33 *
Tjur[c] R^2	0.00	0.02	0.06

Note. N = 6,550.

* $p<0.05$;

** $p<0.01$;

*** $p<0.001$.

[a] All reported sample sizes were rounded to the nearest 50 to comply with National Center for Education Statistics participant confidentiality requirements

[b] Higher score is more appropriate behavior.

[c] A model-fitting statistic for logistic regression; for additional detail on Tjur R^2, see Allison (2013). With an overall ADHD diagnosis rate of .024, and these data, it has a maximum value of .202

Table 3

Logistic Regression Models (Odds Ratios) of Being in Lowest 9.2% of Score Distribution on 60-Month Teacher Ratings ADHD-related Behavioral Functioning (N = 4,900)[a].

	Model 1	Model 2	Model 3
Race/ethnicity (vs. White)			
Black	1.56**	0.89	1.05
Hispanic	1.26	1.11	1.27
Other race/ethnicity	1.09	1.03	1.07
Socio-demographics (24, 60 months)			
Age, 60 months		1.04	1.05
Male		2.90***	2.73***
Second lowest SES quintile, 24 months		1.08	1.06
Middle SES quintile, 24 months		0.95	1.05
Second highest SES quintile, 24 months		0.84	0.94
Highest SES quintile, 24 months		0.48*	0.56
Non-singleton		0.55**	0.59*
Mother 35 years old or older at time of birth		0.71	0.69
Mother not married, 24 months		1.14	1.19
No biological father in household, 24 months		1.23	1.17
Midwest		0.69	0.68
South		0.83	0.81
West		0.66	0.67
Suburban		0.90	0.91
Rural		0.73	0.74
Perinatal and birth conditions (0 months)			
Very low birth weight		1.58*	1.56*
Moderately low birth weight		1.42	1.46
Labor complications		1.17	1.13
Obstetric procedures		0.87	0.88
Medical risk factors at birth		1.40**	1.34
Behavioral risk factors at birth		1.39	1.42
Cognitive functioning (24 months)			
Number of words spoken		0.78*	0.78*
Bayley score		0.86	0.92
Parenting quality (24 months)			
HOME score		0.88	0.93
Two Bags score		1.04	1.02
Family conditions (24 months)			
Mother had mental illness		1.82**	1.75**
Limited health insurance coverage		1.37	1.29
Non-English is primary language at home		0.59	0.64

	Model 1	Model 2	Model 3
ADHD by 60 months			6.69***
Tjur[b] R^2	0.00	0.08	0.10

Note. N = 4,900.

* $p<0.05$;

** $p<0.01$;

*** $p<0.001$.

[a] All reported sample sizes were rounded to the nearest 50 to comply with National Center for Education Statistics participant confidentiality requirements;

[b] A model-fitting statistic for logistic regression; for additional detail on Tjur R^2, see Allison (2013). With a dependent variable mean rate of .092, and these data, it has a maximum value of .447.