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Who Receives a Diagnosis of Attention-Deficit/Hyperactivity Disorder in the United States Elementary School Population?

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ABSTRACT

OBJECTIVE. To investigate factors that are associated with the probability of attention-deficit/hyperactivity disorder (ADHD) diagnosis among U.S. elementary school children, including child, family, school, and policy factors.

METHODS. Logistic regression was used to estimate relative risks associated with independent variables using a nationally representative sample of 9278 children in the 2002 follow-up of the Early Childhood Longitudinal Survey–Kindergarten Cohort. Most children in the sample were in third grade at this point. Previous ADHD diagnoses by professionals were reported by parent respondents.

RESULTS. A total of 5.44% of children were reported to have received an ADHD diagnosis. Girls, black children, and Hispanic children were less likely to have the diagnosis even after controlling for other characteristics. Living with one's biological father was negatively associated with ADHD diagnosis. We also found regional variation in diagnosis with the western region of the United States having significantly lower instances of ADHD cases. Higher diagnosis rates were associated with having an older teacher, and lower rates were associated with having a white teacher, relative to a nonwhite teacher. In schools that were subject to stricter state-level performance accountability laws, we found higher odds of ADHD diagnoses, but we found no differences associated with larger class sizes or the presence of state laws that restrict school personnel from discussing ADHD treatment options with parents.

CONCLUSIONS. ADHD diagnosis is likely to be influenced by a child's social and school environment as well as exogenous child characteristics. Concerns that increased pressures for school performance are associated with increased ADHD diagnoses may be justified.

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Key Words
attention deficit, hyperactivity, mental health, school health

Abbreviations
ADHD—attention-deficit/hyperactivity disorder
DSM-IV—*Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition*
ECLS-K—Early Childhood Longitudinal Survey–Kindergarten Cohort
OR—odds ratio
CI—confidence interval

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ATTENTION-DEFICIT/HYPERACTIVITY DISORDER (ADHD) is the most commonly diagnosed childhood behavioral disorder. Although the National Institute of Mental Health's Methods for the Epidemiology of Child and Adolescent Mental Disorders study in the 1990s estimated its prevalence at 3% to 5% of school-aged children, diagnostic guidelines that were released in 2000 estimated the prevalence of ADHD to be between 4% and 12%.[1–5] The broader diagnostic criteria of the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV), greater acceptance of medication treatments, and higher awareness of the disorder may be contributing to a growth in ADHD diagnosis rates.

Much of the concern and controversy surrounding the growth in ADHD rates in the United States stems from the perception that the diagnosis results more from children's environments than from their actual conditions per se.[6–8] The inherent subjectivity of the DSM-IV criteria[1] (which include items such as "often has difficulty organizing tasks or activities") allows for a range of people (eg, parents, teachers, health professionals), organizations (eg, schools, insurers), and environmental factors (eg, cultural attitudes, public policy) to influence the diagnosis process. As a result, ADHD diagnosis lacks standardization,[9] and ADHD rates vary substantially by gender, ethnicity, geographic area, and other contextual factors.[9–15]

ADHD diagnosis is subject to a variety of influences, particularly because it is often first suggested by school teachers and parents rather than health professionals. Specifically, Sax and Kautz[16] reported that in most cases, an ADHD diagnosis was first suggested by a child's teacher or other school personnel (52.4%), followed by parents (30.2%). The diagnosis was first suggested by a primary care physician or a child psychiatrist or psychologist in only 14.4% of cases.[16] Furthermore, regardless of who first suggests the diagnosis, physicians and mental health professionals typically depend on reports by parents, teachers, and other school personnel in determining a diagnosis.[9]

The sensitivity of the diagnosis to various factors raises questions such as the following: Are diagnosis and treatment of ADHD equitable across individuals and communities in the United States? Does the diagnosis represent a problem with a child or a problem with the setting in which that child lives? These and other concerns have been discussed by a variety of people and organizations, but there are limited data with which to evaluate them.[6–8]

A first step in addressing these concerns is to determine which factors are more or less likely to be associated with ADHD diagnoses. A number of studies show that ADHD diagnosis rates vary substantially by child characteristics such as gender and ethnicity as well as by season of birth.[10–13,17–21] The impacts of family characteristics and socioeconomic status on diagnosis and treatment of ADHD in children remain unclear. In some samples, low family income and family poverty status were associated with lower probabilities of diagnosis.[13,19,22] A recent study by Ford et al,[23] in contrast, found no independent association between ADHD diagnosis and socioeconomic and family characteristics. Another potentially important factor is geographic variation in practice patterns. Recent research has shown wide variation across states and counties in psychostimulant consumption rates.[24] Also, in some samples, rural and semirural residences were associated with reduced likelihood of ADHD diagnosis and service use.[12,25]

Despite that teacher and other school personnel often are the first to suggest ADHD diagnosis, existing literature provides little empirical evidence about the roles of the school's and the teacher's characteristics in ADHD identification.[16] Ford et al[23] found no independent associations between childhood psychiatric disorder and school characteristics in Great Britain. Parents, policy makers, and others have expressed concerns about teachers' and schools' putting pressure on parents to place their children on psychostimulant medication (eg, Ritalin; Ciba-Geigy Corp, Tarrytown, NY) to treat ADHD. Several states have enacted laws to limit the role of schools in diagnosing and treating ADHD, and federal legislation (Child Medication Safety Act) is under discussion. By the time of data collection in this study (spring 2002), Connecticut and Illinois had enacted legislation that prohibited teachers in public schools from recommending that students be evaluated by an appropriate medical practitioner or given psychotropic drugs. Connecticut introduced the law (AB 5701) in January 2001 and Illinois in January 2002 (SB 1718). By the end of 2003, other states, such as Virginia and Michigan, introduced and passed similar laws. As part of our analysis, we tested whether such laws were associated with reduced ADHD diagnoses.

Most notable, our study can contribute to knowledge of factors that are associated with ADHD diagnosis in 3 respects. First, we examined reported ADHD diagnoses in a large, nationally representative community sample of ~9000 children, mostly third graders, who were 7 to 11 years of age. Previous studies of factors that are associated with ADHD diagnosis have used smaller, local, and mostly clinical samples. Second, we examined a variety of characteristics that have not been studied in this type of analysis, such as class size and school accountability laws. Third, unlike most previous studies, we examined the independent associations of various factors with ADHD diagnoses through a multivariate analysis.

METHODS

Sample

We analyzed data from the Early Childhood Longitudinal Survey–Kindergarten Cohort (ECLS-K), a longitudi-

nal data set that is nationally representative of the cohort that began kindergarten (typically at age 5) in fall 1998. ECLS-K is produced and made publicly available by the U.S. Department of Education. Through the standard application process, we obtained a license to use a restricted version of this data set. We analyzed measures that were recorded in spring 2002, at which time children were in third grade unless they had skipped (0.3%) or repeated (8.7%) 1 or more grades. ECLS-K contains detailed information from several sources: standardized tests that were administered to the sample children and surveys of parents, teachers, other school personnel, and the sample children.

The sample size ranged from 5998 to 9278 depending on which set of variables we included in the analysis. There is range because parent and teacher data were not complete for all children. We used sampling weights that were constructed by ECLS-K to adjust for missing data. The procedures that were used to construct these weights are described in detail in a data manual produced by the National Center for Education Statistics.[26]

Measures

Reported ADHD Diagnosis (Dependent Variable)

ADHD diagnoses were reported by parents. In 3 separate questions, the parent respondent (in most cases the mother) was asked whether the child had ever had problems related to (1) learning, (2) attention, or (3) activity level. For each of these questions, when the parent answered yes, a follow-up question was asked regarding whether the child had ever received a professional diagnosis. When the answer again was yes, the parent was asked what the primary diagnosis had been. We coded a child as having a parent-reported ADHD diagnosis when "attention-deficit/hyperactivity disorder (ADHD)" or "attention deficit disorder (ADD)" was noted in any of these follow-up questions.

Child Characteristics

We included the following child characteristics in the analysis: gender, ethnicity, low birth weight (<5 pounds), season of birth, and teacher-reported externalizing problem behavior. The parent respondent provided ethnicity, birth weight, and season of birth information. To assess externalizing problem behavior, the producers of ECLS-K constructed a scale from 1 to 4 (with 4 being the highest degree of such behavior) on the basis of a series of 6 questions that were answered by the teacher regarding the child's behavior.[26] These questions pertained to the frequency with which a child argued, fought, got angry, acted impulsively, disturbed ongoing activities, and talked during quiet study time.

Previous research provided guidance regarding whether child characteristics were likely to be positive or negative predictors of ADHD diagnoses (Table 1). Likely positive predictors included being male, being white, and having a higher level of teacher-reported externalizing problem behavior. Likely negative predictors included being female and nonwhite. We also hypothesized that children who were young for their grade (ie, born in the summer if the cutoff birth date for grades is in the fall) were more likely to seem impulsive or otherwise immature and to be identified as having ADHD.

TABLE 1 Hypothesized Predictors of ADHD Diagnoses

Positive predictors
Male
White
Born in summer months (June, July, August)
Parents born in the United States
Urban location
Teacher's perception that job security depends on student performance
School accountability laws
Negative predictors
Female
Nonwhite
Living with biological parents
Laws that restrict school personnel from recommending ADHD diagnosis or treatment

Family Characteristics

All family characteristics that were included in the analysis were reported by the parent respondent. These measures included the following: whether the mother's age at birth of the sample child was either <18 or >38 years, current presence of each biological parent, each parent's highest educational attainment, whether each parent was born in the United States, family income quintile, and whether either parent was deceased. Highest educational attainment was categorized as less than a high school degree, a high school degree, or a college degree or higher. Family income quintile was constructed on the basis of the distribution of family incomes reported in the sample.

On the basis of previous research,[27] we hypothesized that the absence of 1 or both parents, being a proxy for higher level of family stress, would be a positive predictor of ADHD diagnosis. We hypothesized that having US-born parents would be positively related to the ADHD identification because these families may be more likely and able to seek the health care and special education provisions that frequently result from an ADHD diagnosis. For all other variables, we either had no clear basis for a hypothesis or believed that multiple mechanisms would offset each other. An example of the latter case was higher family income, which could be associated with a higher probability of seeking medical advice but also a lower probability of having behavioral problems.

Geographic Characteristics

Geographic characteristics included region in the United States (South, West, Midwest, and Northeast) as defined

by the US Census Bureau and urban type (rural, small town, large town, medium suburb, large suburb, medium city, and large city) as defined in the data manual.[26] On the basis of published reports, we hypothesized that urban location would be a positive predictor of ADHD diagnosis.[12,25]

Teacher Characteristics

We included in the analysis the following characteristics of the child's current teacher: gender, age, white or nonwhite, and whether the teacher worried about job security because of students' performance on state or local tests. These measures all were reported by the teacher.

In the absence of empirical evidence from previous research, we hypothesized that the teacher's perception that job security depended on student performance would be positively associated with ADHD diagnoses. We based our hypothesis on the idea that linking job security to child's academic performance may pressure teachers to recommend treatments that have been shown to improve academic performance or to seek diagnoses that exclude children from the class or school performance calculation.

School Characteristics

As reported by a school administrator, school characteristics in the analysis included public or private status, religious affiliation (if private), average class size, and percentage of minorities. Because of multiple mechanisms that may offset each other and the lack of guidance from previous literature, we had no clear basis for formulating hypotheses regarding school characteristics.

State Policies

We examined 2 state-level policies that may be relevant to ADHD diagnosis prevalence. The first is school performance accountability. States were categorized on a scale from 0 to 4 according to how many of the following types of school accountability measures they had as of spring 2002: report cards, ratings, rewards based on scores, and sanctions based on scores. Second, we included dummy variables equal to 1 for the states (Connecticut and Illinois) with laws that restrict school personnel from discussion of ADHD and related medication as of spring 2002.

We hypothesized that in the presence of accountability laws, ADHD diagnosis prevalence would be higher, and in the presence of the laws that restrict discussion related to ADHD, diagnosis prevalence would be lower. With accountability laws, teachers and schools would have extra incentives to recommend a diagnosis that could lead to treatments that have been shown to improve academic performance and reduce problem behaviors.

Statistical Analysis

We performed paired *t* tests to compare the values of means for children with and without a diagnosis of ADHD. For each measure reported, *t* statistics represent tests of the null hypothesis of no difference between children with and without a diagnosis of ADHD; the associated *P* values show whether the observed difference between the means is statistically different from 0. Note that sample means do not show independent associations between ADHD and other characteristics in our analysis.

To establish factors that were independently associated with the probability of ADHD diagnosis, we performed logistic regressions. We present results as estimated odds ratios (ORs) with Z statistics adjusted for ECLS-K's clustered, stratified sample design using pseudo-maximum likelihood estimators.[27] All statistical analyses were done using Stata 8.0.[28]

We performed 3 logistic regressions, each with different sets of independent variables: (1) child characteristics; (2) child, family, and geographic characteristics; and (3) child, family, geographic, teacher, and school characteristics and state policies. Including these increasingly broad sets of variables allowed us to observe the extent to which differences in diagnosis prevalence across child characteristics such as gender and race/ethnicity may be attributable to confounding factors.

RESULTS

As shown in Table 2, the estimated prevalence of ADHD diagnosis was 5.44%. Table 2 also reports means for all independent variables in the analysis for the whole sample and by ADHD diagnosis status. Paired *t* tests indicated that the means of several variables differed across ADHD status. Children who received a diagnosis of ADHD were less likely to be female (21.9%) than children without a diagnosis of ADHD (50.0%). There was significant variation across (self-reported) race categories; children who had a diagnosis of ADHD were 80.5% white (vs 61.9% of children without a diagnosis of ADHD), 5.54% black (vs 9.6%), 8.6% Hispanic (vs 21.0%), and 0.48% Asian (vs 3.56%). Other differences in means across ADHD diagnosis status that were significant at the 95% confidence level included the following: having had a summer or fall birth, having had a mother who was older than 38 at the child's birth, living with either biological parent, having a father who finished college, having a mother who finished college, having US-born parents, being in the second or fifth family income quintile, having a deceased parent, living in the South or the West, living in a large city, having a male teacher, teacher's age, average class size, being in a public school or Catholic school, percentage of minorities in school, and school performance accountability laws.

Table 3 shows independent associations of the probability of an ADHD diagnosis with various child, family,

TABLE 2 **Variable Means: Overall, ADHD, and non-ADHD Samples**

	Overall Sample ($n = 9278$)	ADHD Sample ($n = 433$)	Non-ADHD Sample ($n = 8845$)	*T* Statistic, ADHD Versus Non-ADHD
Child characteristics				
ADHD	0.0544	—	—	—
Female	0.485	0.219	0.50	10.39[a]
White (not Hispanic)	0.625	0.805	0.615	−6.68[a]
Black	0.0937	0.0554	0.096	2.04[b]
Hispanic	0.203	0.0858	0.210	4.18[a]
Asian	0.0339	0.00482	0.0356	4.95[a]
Native American	0.0146	0.00904	0.0149	0.642
Hawaiian-Pacific Islander	0.00802	0.00947	0.00794	−0.637
Multiracial	0.0212	0.0302	0.0207	−0.442
Low birth weight	0.0612	0.0614	0.0586	−0.654
Winter (Dec–Feb) birth	0.223	0.200	0.224	1.36
Spring (Mar–May) birth	0.242	0.244	0.241	−0.584
Summer (Jun–Aug) birth	0.277	0.346	0.273	−3.949[a]
Fall (Sep–Nov) birth	0.259	0.210	0.262	2.15[b]
Teacher-reported externalizing problem behavior (1–4 scale)	1.66 (0.589)	2.184 (0.719)	1.64 (0.568)	−17.75[a]
Family characteristics				
Mother <18 at birth	0.0434	0.0615	0.0424	−0.957
Mother >38 at birth	0.0348	0.0138	0.0360	2.41[b]
Living with biological father	0.820	0.631	0.831	9.51[a]
Living with biological mother	0.949	0.869	0.954	7.08[a]
Father finished high school	0.847	0.864	0.846	−0.226
Father finished college	0.290	0.222	0.294	4.10[a]
Mother finished high school	0.871	0.888	0.870	−0.614
Mother finished college	0.272	0.246	0.273	2.01[b]
US-born father	0.801	0.925	0.794	−6.58[a]
US-born mother	0.804	0.949	0.795	−7.10[a]
First income quintile	0.137	0.117	0.138	0.334
Second income quintile	0.200	0.285	0.195	−2.84[a]
Third income quintile	0.204	0.188	0.204	0.239
Fourth income quintile	0.220	0.219	0.220	0.0507
Fifth income quintile	0.239	0.191	0.242	2.31[b]
One of the parents died	0.0133	0.0245	0.0127	−2.48[b]
Geographic characteristics				
South	0.333	0.433	0.327	−4.74[a]
Northeast	0.187	0.154	0.189	1.13
West	0.235	0.133	0.241	5.63[a]
Midwest	0.245	0.281	0.242	−1.40
Rural	0.132	0.153	0.131	−0.709
Large city	0.142	0.0849	0.145	3.244[a]
Medium city	0.195	0.199	0.194	−0.600
Large suburb	0.327	0.325	0.327	1.07
Medium suburb	0.0809	0.111	0.0792	−1.43
Large town	0.0377	0.0390	0.0376	−0.633
Small town	0.0852	0.0891	0.0849	−0.572
Teacher characteristics				
Male teacher	0.0648	0.0455	0.0659	1.99[b]
White teacher	0.889	0.869	0.890	0.33
Teacher's age	43.2 (11.2)	44.94 (10.9)	43.1 (11.3)	−2.57[b]
School characteristics				
Average class size	21.2 (4.54)	20.77 (3.89)	21.3 (4.57)	2.86[a]
Public school	0.870	0.913	0.868	−2.41[b]
Catholic school	0.0702	0.0447	0.0716	2.89[a]
Other religious school	0.0483	0.0352	0.0491	1.42
Other private school	0.0114	0.00684	0.0117	1.18
Percentage of minorities	35.85 (33.21)	27.5 (27.2)	36.3 (33.5)	4.50[a]
State policies				
School performance accountability	2.71 (1.14)	2.74 (1.24)	2.70 (1.13)	−2.16[b]
State ADHD laws	0.0448	0.0344	0.0454	0.263

SDs in parentheses for nonbinary variables.

[a] $P < .01$.

[b] $P < .05$.

TABLE 3 **ADHD Identification: Logistic Regression Results**

	OR (95% CI)	OR (95% CI)	OR (95% CI)
Child characteristics			
Female	0.401[a] (0.295–0.544)	0.363[a] (0.257–0.515)	0.387[a] (0.267–0.562)
White	1.0	1.0	1.0
Black	0.260[a] (0.133–0.509)	0.187[a] (0.0789–0.443)	0.0928[a] (0.0315–0.273)
Hispanic	0.263[a] (0.166–0.415)	0.393[a] (0.224–0.687)	0.335[a] (0.175–0.643)
Asian	0.212[b] (0.0444–1.01)	0.123[b] (0.0142–1.06)	0.0715[c] (0.00668–0.766)
Native American	0.693 (0.116–4.13)	0.292 (0.0518–1.65)	0.198 (0.0272–1.45)
Hawaiian-Pacific Islander	0.474[c] (0.232–0.967)	1.19 (0.503–2.81)	1.26 (0.597–2.68)
Multiracial	1.98 (0.863–4.54)	2.67[c] (1.09–6.55)	3.06[c] (1.27–7.38)
Low birth weight	0.691 (0.435–1.10)	1.18 (0.586–2.37)	1.14 (0.529–2.47)
Winter birth	1.0	1.0	1.0
Spring birth	1.00 (0.622–1.62)	1.19 (0.743–1.91)	1.33 (0.842–2.10)
Summer birth	1.35 (0.864–2.11)	1.69[c] (1.09–2.61)	1.69[c] (1.10–2.61)
Fall birth	0.949 (0.595–1.51)	0.968 (0.62–1.51)	0.936 (0.591–1.48)
Teacher-reported externalizing problem behavior (1–4 scale)	3.01[a] (2.465–3.69)	2.90[a] (2.28–3.68)	3.11[a] (2.43–3.98)
Family characteristics			
Mother <18 at birth		0.339[c] (0.143–0.803)	0.280[c] (0.105–0.745)
Mother 18–38 at birth		1.0	1.0
Mother >38 at birth		0.179[c] (0.0465–0.689)	0.0995[a] (0.020–0.491)
Living with biological father		0.490[a] (0.323–0.746)	0.455[a] (0.306–0.677)
Living with biological mother		0.697 (0.346–1.406)	0.645 (0.308–1.35)
Father finished high school		1.11 (0.493–2.51)	1.22 (0.538–2.77)
Father finished college		0.652 (0.365–1.16)	0.697 (0.375–1.29)
Mother finished high school		1.93 (0.759–4.91)	1.96 (0.805–4.76)
Mother finished college		0.995 (0.641–1.54)	0.986 (0.612–1.59)
US-born father		2.74[c] (1.14–6.57)	2.54[b] (0.967–6.65)
US-born mother		1.25 (0.555–2.83)	1.40 (0.569–3.47)
First income quintile		2.06 (0.742–5.73)	2.50[b] (0.869–7.17)
Second income quintile		1.64[c] (1.0–2.69)	1.49 (0.893–2.47)
Third income quintile		1.0	1.0
Fourth income quintile		1.03 (0.699–1.54)	0.995 (0.637–1.55)
Fifth income quintile		1.50 (0.708–3.20)	1.52 (0.681–3.38)
One of the parents died		0.539 (0.0388–7.48)	0.501 (0.0149–16.83)
Geographic characteristics			
Midwest		1.0	1.0
Northeast		0.828 (0.535–1.28)	0.721 (0.464–1.12)
South		1.12 (0.808–1.55)	0.579[b] (0.314–1.07)
West		0.612[c] (0.381–0.982)	0.386[a] (0.221–0.673)
Rural		0.763 (0.411–1.31)	0.769 (0.421–1.40)
Large city		0.941 (0.50–1.77)	1.00 (0.00)
Medium city		1.03 (0.550–1.92)	1.24 (0.636–2.42)
Large suburb		1.19 (0.714–2.0)	1.38 (0.812–2.35)
Medium suburb		1.0	1.0
Large town		0.770 (0.341–1.74)	0.715 (0.328–1.56)
Small town		0.796 (0.419–1.51)	1.01 (0.498–2.07)
Teacher characteristics			
Male teacher			0.641 (0.277–1.48)
Teacher's age			1.02[a] (1.01–1.04)
White teacher			0.468[c] (0.261–0.838)
Job security based on performance			0.942 (0.612–1.45)
School characteristics			
Average class size			0.974 (0.927–1.02)
Percentage of minorities			1.01 (0.998–1.01)
Public school			0.423 (0.084–2.12)
Catholic school			0.171[c] (0.0297–0.983)
Other religious school			0.167[c] (0.0293–0.955)
State policies			
School performance accountability			1.32[c] (1.05–1.65)
State ADHD laws			0.953 (0.548–1.66)
Sample size	$n = 9050$	$n = 6607$	$n = 5998$

[a] $P < .01$.
[b] $P < .10$.
[c] $P < .05$.

geographic, teacher, school, and policy characteristics, as estimated by logistic regressions. We report the OR and 95% confidence intervals (CIs). In general, the estimated ORs were similar across specifications, so we discuss here only the estimates from the specification with the full set of covariates (the third column of estimates in Table 2).

Children who had a diagnosis of ADHD were less likely to be female: girls were 0.387 times (95% CI: 0.267–0.562) as likely to receive a diagnosis as boys after we controlled for all of the covariates. Black (OR: 0.0928; 95% CI: 0.0315–0.273), Hispanic (OR: 0.335; 95% CI: 0.175–0.643), and Asian (OR: 0.0715; 95% CI: 0.00668–0.766) children were less likely than white children to receive a diagnosis of ADHD, whereas multiracial children were more likely (OR: 3.06; 95% CI: 1.27–7.38). The ORs that were associated with the black and Asian race categories became smaller after we controlled for more covariates, suggesting that confounders masked some portion of the disparities in the unadjusted comparisons. Being born in the summer was associated with higher rates of ADHD (OR: 1.69; 95% CI: 1.10–2.61). Children who were perceived by teachers as having a higher degree of externalizing problem behavior were 3 times more likely to receive a diagnosis (95% CI: 2.43–3.98) for each point on the 1 to 4 behavior scale.

Some family characteristics were also important predictors of the ADHD diagnosis. Children who had a diagnosis were less likely to live with a biological father (OR: 0.455; 95% CI: 0.306–0.677) and more likely to have a US-born father (OR: 2.54; 95% CI: 0.967–6.65). Maternal age at birth was also significant: children who had a diagnosis of ADHD were less likely to have a mother who was younger than 18 years (OR: 0.280; 95% CI: 0.105–0.745) or older than 38 years at the time of the child's birth (OR: 0.0995; 95% CI: 0.0202–0.491). Finally, being in the lowest income quintile was associated with a higher probability of ADHD diagnosis (OR: 2.54; 95% CI: 0.869–7.17) than being in the middle income quintile.

Relative to children in the Midwest, children in the South (OR: 0.579; 95% CI: 0.314–1.07) and in the West were less likely (OR: 0.386; 95% CI: 0.221–0.673) to have received a diagnosis of ADHD. Other geographic characteristics and urbanicity types were not significant at the 95% confidence level.

Because teachers and schools play an important role in identification of children with ADHD, their independent associations with the diagnosis were of great interest. Results indicated that ADHD diagnoses were less prevalent among children with white teachers, relative to those with nonwhite teachers (OR: 0.468; 95% CI: 0.261–0.838) but more prevalent in classes with older teachers (OR: 1.02; 95% CI: 1.01–1.04). Children who attended Catholic (OR: 0.171; 95% CI: 0.0297–0.983) or other religious schools (OR: 0.167; 95% CI: 0.0293–0.955) were less likely to have received a diagnosis.

We also found a positive association between school accountability laws and the probability of ADHD diagnosis: stricter accountability for student performance was associated with an increase in the odds of ADHD diagnosis by a factor of 1.32 (95% CI: 1.05–1.65) for each point on the 0 to 4 accountability index. By contrast, we did not find a significant relationship between the probability of ADHD diagnosis and average class sizes or the presence of state laws that restrict teachers from discussing ADHD diagnosis and treatment with parents.

DISCUSSION

This study examined a variety of factors that are related to ADHD diagnosis using a nationally representative community sample. Our results emphasize the importance of the family context as well as the school environment and policies in ADHD diagnosis. Even after we controlled for the children's externalizing behaviors (as reported by the teacher), significant relationships remained between the probability of diagnosis and a variety of contextual factors.

From a policy perspective, it is difficult to say whether the observed positive relationship between state-level school accountability laws and ADHD diagnosis rates is a cause for concern. On the one hand, this relationship may reflect an intended and desirable outcome: teachers who are more motivated to improve students' academic performance may be more likely to identify and help potential ADHD cases. On the other hand, as many people have worried, the pressures that accompany such laws also may encourage teachers to persuade parents to treat students with psychostimulant drugs, rather than address other possible aspects of the situation (eg, large class size, suboptimal teaching methods).

Although we found no relationship between ADHD diagnosis rates and the presence of state laws that restrict school personnel from discussing ADHD treatments with parents, we note that only 4.5% of children in our sample lived in the 2 states that had adopted such laws by spring 2002. Thus, we were unable to estimate a relationship precisely. In addition, many of the children in our sample undoubtedly received a diagnosis before the date when the state laws that restrict ADHD diagnosis by school teachers and personnel were enacted. The effects of these laws on diagnosis and treatment rates may become more apparent as more states adopt the laws, the longer the laws are on the books, and as more data are available. It is also important to note that such laws may be more likely to be implemented in states with high ADHD prevalence that can offset the estimated effect of ADHD state laws in our analysis.

At the school level, we found that children in Catholic and other religious schools were less likely to receive ADHD diagnoses, but this result should be interpreted

with caution because of potential self-selection of children into private schools.

As in other studies,[10–12,17–19] we found that girls were less likely to receive a diagnosis. More information about attention disorders and their symptoms in girls for both teachers and parents may narrow the gap between genders. Also, our study reinforces the evidence from previous research of cultural and ethnic differences in the diagnosis of ADHD.[12,13,19] More education outreach may be necessary to improve information about ADHD and its treatments to ethnic and cultural subgroups because nonwhite children and children of foreign-born parents receive diagnoses at lower rates than their peers even after we control for family income and other characteristics. Conversely, many would argue that ADHD in white children in particular is overdiagnosed. That relative probabilities of diagnosis for black and Asian children became even smaller after we controlled for a full set of contextual covariates indicates that the disparities are even greater than those indicated by raw rates.

Although our results do not support previous findings of a significant relationship between September and winter births and ADHD,[20] examining the time of year when children were born yielded an interesting pattern. Children who were born in the "summer" months (by our definition, June, July, and August) were ~1.7 times more likely to have received a diagnosis of ADHD than those who were born in the winter months (December, January, and February). Given that schools typically have cutoff dates for grade assignment in early fall, we speculate that this result may have been attributable to the fact that children who are born in the summer are generally the youngest in their grade; their ability to focus on tasks and their behavior in general may have seemed more ADHD-like, relative to somewhat older peers. The estimated ORs for spring and fall births, although not significantly different from winter births, suggest that the probability of diagnosis increases in the order of fall, winter, spring, and summer births.

Our study also contributes to the debate surrounding the impact of family characteristics and socioeconomic status on children with a diagnosis of ADHD.[13,19,22,23] We found evidence suggesting that family factors play an important role in ADHD diagnosis. Living with one's biological father was associated with a lower probability of diagnosis, whereas having a US-born father was associated with a higher probability of diagnosis. Results for socioeconomic status, as measured by income quintile, suggested that there is no simple linear relationship but that children at the lowest quintile are most likely to receive a diagnosis.

An important limitation of this study, of course, is that none of the independent variables were randomly assigned to individuals. Thus, one must be cautious in applying causal interpretations to the relationships uncovered in the data. Furthermore, we cannot disentangle the extent to which correlations between factors and ADHD diagnosis probability represent risk factors for having a "true" condition as opposed to factors that affect the likelihood of diagnosis, given a certain level of "true" condition. Indeed, given the subjectivity of the criteria for ADHD in the DSM-IV, no amount of data can completely separate these relationships. Another limitation is that we examined a sample of children from the start of kindergarten to the third grade only. The relationships between variables may be different for children of other ages. Also, our diagnosis data were based on parents' reports and may be misreported in some cases. This would bias our results if underreporting or overreporting were systematically related to the independent variables that we studied. We are not aware of any research that has examined this concern.

Another limitation is that we could not compare key variables in the original sample at baseline (fall 1998) with the sample used in our analysis (spring 2002) because these variables (eg, parent perceptions, ADHD diagnosis) naturally change between kindergarten and third grade. Thus, although we used statistical weights to account for any changes in basic characteristics in the sample (eg, demographics), sample attrition still may have affected the key variables in our analysis. It is less likely, however, that sample attrition substantially affected the relationships between these key variables, which were the focus of our study.

CONCLUSIONS

ADHD diagnosis is likely to be influenced by a child's social and school environment as well as by exogenous child characteristics. Diagnosis disparities across gender, racial, and ethnic groups probably stem from a variety of factors and deserve careful attention.

Schools play an important role in ADHD identification. We found that increased pressures for school performance under accountability laws are associated with increased ADHD diagnoses. Empirical evidence shows that state laws by the time of this study did not significantly affect ADHD diagnoses. State laws that limit teachers' ability to talk to parents about ADHD have a potential to have significant consequences as they stay in effect longer and as more states adopt such laws. More research is necessary to examine the impact of state laws as they affect more children over time.

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