ARTICLE

Prevalence, Recognition, and Treatment of Attention-Deficit/Hyperactivity Disorder in a National Sample of US Children

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Objective: To determine the US national prevalence of attention-deficit/hyperactivity disorder (ADHD) and whether prevalence, recognition, and treatment vary by socioeconomic group.

Design: Cross-sectional survey.

Setting: Nationally representative sample of the US population from 2001 to 2004.

Participants: Eight- to 15-year-old children (N=3082) in the National Health and Nutrition Examination Survey.

Main Outcome Measures: The Diagnostic Interview Schedule for Children (caregiver module) was used to ascertain the presence of ADHD in the past year based on *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition) (*DSM-IV*) criteria. Prior diagnosis of ADHD by a health professional and ADHD medication use were assessed by caregiver report.

Results: Of the children, 8.7% met *DSM-IV* criteria for ADHD. The poorest children (lowest quintile) were more likely than the wealthiest (highest quintile) to fulfill criteria for ADHD (adjusted odds ratio [AOR], 2.3; 95% confidence interval [CI], 1.4-3.9). Among children meeting *DSM-IV* ADHD criteria, 47.9% had a prior diagnosis of ADHD and 32.0% were treated consistently with ADHD medications during the past year. Girls were less likely than boys to have their disorder identified (AOR, 0.3; 95% CI, 0.1-0.8), and the wealthiest children were more likely than the poorest to receive regular medication treatment (AOR, 3.4; 95% CI, 1.3-9.1).

Conclusions: Of US children aged 8 to 15 years, 8.7%, an estimated 2.4 million, meet *DSM-IV* criteria for ADHD. Less than half of children meeting *DSM-IV* criteria report receiving either a diagnosis of ADHD or regular medication treatment. Poor children are most likely to meet criteria for ADHD yet are least likely to receive consistent pharmacotherapy.

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DESPITE WIDESPREAD CONcern that the rate of attention-deficit/hyperactivity disorder (ADHD) is on the rise,[1] the national population-based prevalence of ADHD in US children has not been firmly established. Prior national population-based studies of American children have primarily used parental report of an ADHD diagnosis, medical record review, or medication use[2-9] as proxies for a formal ADHD diagnostic assessment. Other studies have applied *Diagnostic and Statistical Manual of Mental Disorders* (Third Edition)[10] *(DSM-III), Diagnostic and Statistical Manual of Mental Disorders* (Third Edition–Revised)[11] (*DSM-III-R*), and *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition)[12] (*DSM-IV*) criteria to determine diagnostic status, but those samples have been regional or multisite cohort studies.[13-30] Owing to differing methods of determining diagnostic status and regional variations in prevalence, estimates of ADHD prevalence in community-based American samples have ranged from 2% to 26%.[13-30] To our knowledge, to date, no US nationally representative population-based studies using *DSM-IV* criteria for ADHD have been conducted in children.

In addition to ambiguity regarding overall ADHD prevalence, there is uncertainty about prevalence of the ADHD subtypes. The *DSM-IV* ADHD subtypes are useful because each is differentially associated with delinquency, comorbid conditions, and life outcomes.[31] Most of what is known about ADHD subtype prevalence comes from clinic-based samples, which have demonstrated higher rates of ADHD–combined type (ADHD-CT) than the other subtypes.[31,32] However, international and US regional population-based studies have had mixed results, with some

showing a predominance of the inattentive subtype (ADHD-IA)[16,27,33] and others documenting highest rates of ADHD-CT.[30,34,35]

The extent to which the prevalence of ADHD and its subtypes varies by population characteristics, in particular socioeconomic and racial/ethnic status, is also unclear. Although an elevated ADHD prevalence is plausible in lower-income populations because of their higher rates of putative ADHD risk factors such as low birth weight,[36] lead exposure,[37] and in utero tobacco exposure,[38] national studies have not observed a difference in rates by income[9] or have identified income-related differences among boys but not girls.[5] However, because these studies relied on caregiver report of an ADHD diagnosis, the findings may reflect differential access to health care or diagnostic bias. Results from US regional studies using *DSM-III, DSM-III-R,* and *DSM-IV* criteria to study ADHD rates in different income groups have varied, with 2 documenting an elevated ADHD prevalence in lower-income children and 1 finding no difference.[21,24,25] Studies of ADHD rates in US racial/ethnic groups have also been inconsistent. The US national studies have shown lower rates of reported ADHD diagnoses in children from minority backgrounds,[7,9] but 2 regional studies found no difference in *DSM*-based ADHD rates in non-Hispanic white and African American children.[21,30] Little information is available about *DSM*-based rates of ADHD in Mexican American children,[27,39] one of the fasting growing sectors of the US population.

There is also broad public concern about rates of psychostimulant use for ADHD,[40] yet these concerns are difficult to evaluate because most studies have not benchmarked the appropriateness of medication treatment against actual *DSM*-based diagnostic status.[15,28,29] Prior national studies have documented lower rates of ADHD medication use in uninsured children, African American children, and Hispanic children but no difference in use by income.[3,5,41] However, because these studies examined psychostimulant use without information about ADHD symptoms and impairment, it is unclear whether differences in medication use signify undertreatment in specific groups.

The purpose of this study was to examine ADHD prevalence in a national population-based sample of US children assessed with a *DSM-IV*–based diagnostic instrument. We also investigated sociodemographic predictors of ADHD and the likelihood of receiving a prior diagnosis and medication treatment among children who fulfill *DSM-IV* ADHD criteria.

METHODS

SAMPLE

The National Health and Nutrition Examination Survey (NHANES)[42] is an annual multistage probability sample survey of the noninstitutionalized US population, including an oversample of minority populations. A total of 3907 children aged 8 to 15 years participated in NHANES from 2001 to 2004, with data regarding *DSM-IV* ADHD diagnostic status available for 3082 children (78.9% of total). Approximately 10% of children lacked *DSM-IV* ADHD data because they did not complete a previously required survey component at the NHANES mobile examination center, and caregivers of another 10% could not be located for the ADHD interview, refused, or had a primary language other than English or Spanish. Those with *DSM-IV* ADHD information did not differ from those without in terms of sex ($P=.84$), report of prior ADHD diagnosis ($P=.93$), or health insurance status ($P=.45$). However, those lacking *DSM-IV* ADHD data were significantly more likely to be younger (mean age, 9.9 years vs 12.1 years), poorer (lowest income quintile, 24.9% vs 18.9%), and African American (17.0% vs 14.7%).

OUTCOMES

The National Institute of Mental Health Diagnostic Interview Schedule for Children–IV (DISC-IV), a structured diagnostic interview instrument designed for use in epidemiologic studies, was used to assess the presence of ADHD based on *DSM-IV* criteria. This study used the ADHD DISC caregiver module, which has evidence of substantial validity,[43] reliability for both its English[43] and Spanish[44,45] versions, and successful use with the telephone in the *DSM-IV* field trials.[32] Caregivers completed the DISC telephone interview 2 to 4 weeks after the child's NHANES mobile examination center evaluation, providing information about the child's ADHD symptoms, age at onset, symptom pervasiveness, and related impairments during the prior 12 months. The DISC algorithms determine ADHD diagnostic status and ascertain ADHD subtype (ADHD-IA, ADHD-CT, and hyperactive-impulsive type [ADHD-HI]). In addition, questions on the DISC inquire about use of "medicine for being overactive, being hyperactive, or having trouble paying attention" in the past 12 months and whether medication was taken "most of the time during the last year" (ie, consistent medication treatment) (D. J. Brody, MPH, written communications, October 17, 2006). To determine whether a child had been previously diagnosed as having ADHD, caregivers were asked, "Has a doctor or health professional ever told you that [child's name] had attention deficit disorder?"[46] during the administration of a separate NHANES interview module.

PREDICTORS

Predictors considered in these analyses included the child's age, sex, race/ethnicity, household income to poverty line ratio (PIR), and health insurance status. The PIR is the ratio of the reported household income to the poverty threshold appropriate for household size. To capture the distribution across the US population, the PIR was categorized into quintiles. Child race/ethnicity was designated by caregivers and included the following categories: non-Hispanic black, Mexican American, other Hispanic, non-Hispanic white, and other (including multiracial). Because of the small number of subjects in the "other Hispanic" and "other (including multiracial)" groups (n=115 and n=107, respectively), they were combined into a single "other race/ethnicity" category.

ANALYSES

To account for the complex survey design, sample weights and design variables were applied according to National Center for Health Statistics guidelines to generate all estimates. These sample weights were calculated from the base probabilities of selection, adjusted for nonresponse, and poststratified to match population control totals. Analyses were performed using SAS statistical software, version 9 (SAS Institute Inc, Cary, North Carolina), procedures for analysis of complex surveys.

Descriptive statistics on the national prevalence of ADHD and ADHD subtypes are given for the sample overall and across

Table 1. Prevalence of Outcomes and Study Sample Characteristics in 3082 Children

Characteristic	No.	Weighted % (95% CI)
Attention-deficit/hyperactivity disorder[a]		
All types	222	8.7 (7.3-10.1)
Inattentive type	95	4.4 (3.2-5.6)
Combined type	72	2.2 (1.7-2.7)
Hyperactive-impulsive type	55	2.0 (1.2-2.8)
Age, y		
8-11	1160	47.5 (44.9-50.1)
12-15	1922	52.5 (49.9-55.1)
Sex		
Male	1515	51.0 (49.0-53.0)
Female	1567	49.0 (47.0-51.0)
Race/ethnicity		
African American	1025	14.7 (11.3-18.1)
Mexican American	929	12.0 (8.9-15.1)
Other	222	10.8 (7.6-14.0)
White, non-Hispanic	906	62.5 (57.2-67.8)
Poverty to income ratio[b]		
First quintile (0-0.93)	806	18.9 (16.3-21.4)
Second quintile (0.94-1.70)	696	18.8 (16.4-21.1)
Third quintile (1.71-2.75)	541	19.6 (16.6-22.6)
Fourth quintile (2.76-4.24)	477	21.0 (18.5-23.5)
Fifth quintile (>4.25)	444	21.8 (18.2-25.3)
Health insurance status[b]		
Insured	2576	87.8 (85.2-90.5)
Not insured	474	12.2 (9.5-14.8)

Abbreviation: CI, confidence interval.
[a] Met *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition) criteria in the past year.
[b] Values do not sum to total owing to missing data.

Table 2. Prevalence and Adjusted Odds Ratios of Attention-Deficit/Hyperactivity Disorder[a] (All Types) in the Past Year

Characteristic	No.	Weighted % (95% CI)	*P* Value[b]	AOR (95% CI)
Age, y				
8-11	119	10.0 (7.9-12.1)	.08	1.3 (0.9-1.8)
12-15	103	7.5 (5.5-9.4)		1 [Reference]
Sex				
Male	141	11.8 (9.8-13.8)	<.001	2.3 (1.8-2.9)
Female	81	5.4 (4.2-6.6)		1 [Reference]
Race/ethnicity				
African American	76	8.7 (6.4-10.9)	.05	0.7 (0.5-1.1)
Mexican American	45	6.0 (4.3-7.8)		0.5 (0.3-0.8)
Other	17	5.2 (1.8-8.7)		0.4 (0.2-0.9)
White, non-Hispanic	84	9.8 (7.4-12.1)		1 [Reference]
Poverty to income ratio				
First quintile	69	11.0 (7.9-14.0)	.50	2.3 (1.4-3.9)
Second quintile	46	9.6 (4.7-14.5)		1.8 (1.0-3.6)
Third quintile	40	8.5 (4.6-12.5)		1.5 (0.7-3.1)
Fourth quintile	34	9.0 (5.5-12.6)		1.5 (0.9-2.8)
Fifth quintile	28	6.4 (3.6-9.1)		1 [Reference]

Abbreviations: AOR, adjusted odds ratio (from model containing all variables shown in the table); CI, confidence interval.
[a] Met *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition) criteria.
[b] For between-group comparison of prevalence rates in χ^2 analysis.

socioeconomic and racial/ethnic groups. For children meeting *DSM-IV* ADHD criteria, rates of caregiver-reported diagnoses (ie, prior disorder recognition) and medication treatment are also summarized overall and across demographic groupings. We used χ^2 tests to assess bivariate associations between the demographic predictor variables and ADHD diagnostic status, prior disorder recognition, and treatment status. To adjust for the effects of the demographic variables on ADHD status, prior disorder recognition, and history of ADHD treatment, multivariable logistic regression was performed with income, race/ethnicity, age, and sex included as predictors. In addition, for models predicting prior disorder recognition and history of ADHD treatment, health insurance status and ADHD subtype were included to account for differential access to care and the potential bias toward diagnosing and treating children with more externalizing behaviors.

The institutional review board of Cincinnati Children's Hospital Medical Center determined this study to be exempt from its review.

RESULTS

PREVALENCE OF ADHD

Among participants aged 8 to 15 years, 8.7% (95% confidence interval [CI], 7.3%-10.1%) met *DSM-IV* criteria for ADHD in the year prior to the survey, equivalent to 2.4 million children in the United States (**Table 1**). An additional 3.3% (95% CI, 2.4%-4.1%) did not meet *DSM-IV* ADHD criteria but had both a parent-reported prior diagnosis of ADHD and treatment with ADHD medications at some time during the past 12 months. However, the following results focus on those meeting *DSM-IV* ADHD criteria in the past year.

In bivariate analyses, rates of meeting *DSM-IV* ADHD criteria were higher in boys than girls (11.8% vs 5.4%; $P<.001$) and higher in non-Hispanic white children than Mexican Americans or children of "other race/ethnicity" (**Table 2**).

In multivariable models, the poorest children were more than twice as likely as the wealthiest to meet criteria for ADHD (adjusted odds ratio [AOR] for PIR, first quintile vs fifth quintile, 2.3; 95% CI, 1.4-3.9) (Table 2). Multivariable analyses confirmed that boys had an increased likelihood of ADHD (AOR vs girls, 2.3; 95% CI, 1.8-2.9), whereas Mexican Americans and children of "other race/ethnicity" had lower likelihoods compared with non-Hispanic white children (AOR, 0.5; 95% CI, 0.3-0.8, and AOR, 0.4; 95% CI, 0.2-0.9, respectively).

PREVALENCE OF ADHD SUBTYPES

Of the children, 4.4% met criteria for ADHD-IA, 2.2% for ADHD-CT, and 2.0% for ADHD-HI (Table 1). Subtype differences were observed among the various income and racial/ethnic groups (**Table 3**). The poorest children had a higher likelihood of ADHD-HI compared with the wealthiest (AOR for PIR, first vs fifth quintile, 3.1; 95% CI, 1.2-8.3). African Americans and Mexican Americans had a lower likelihood of ADHD-IA rates compared with non-Hispanic white children (AOR, 0.4; 95% CI, 0.2-0.8, for both).

Table 3. Prevalence and Adjusted Odds Ratios of Attention-Deficit/Hyperactivity Disorder[a] Subtypes in the Past Year

Characteristic	Combined Type				Inattentive Type				Hyperactive-impulsive Type			
	No.	Weighted % (95% CI)	*P* Value[b]	AOR (95% CI)	No.	Weighted % (95% CI)	*P* Value[b]	AOR (95% CI)	No.	Weighted % (95% CI)	*P* Value[b]	AOR (95% CI)
Age, y												
8-11	34	2.4 (1.4-3.3)	.61	1.0 (0.6-1.6)	49	4.8 (3.2-6.4)	.47	1.2 (0.8-1.8)	36	2.8 (1.3-4.3)	.03	1.9 (0.9-3.9)
12-15	38	2.1 (1.5-2.6)		1 [Reference]	46	4.1 (2.5-5.6)		1 [Reference]	19	1.3 (0.6-2.0)		1 [Reference]
Sex												
Male	53	3.3 (2.5-4.2)	<.001	3.2 (1.9-5.5)	53	5.7 (3.7-7.6)	.004	1.8 (1.2-2.8)	35	2.8 (1.4-4.2)	.01	2.2 (1.1-4.5)
Female	19	1.0 (0.6-1.5)		1 [Reference]	42	3.1 (2.1-4.1)		1 [Reference]	20	1.2 (0.5-1.9)		1 [Reference]
Race/ethnicity												
African American	32	3.7 (2.1-5.2)	.11	1.6 (0.7-3.4)	25	2.8 (1.5-4.0)	.02	0.4 (0.2-0.8)	19	2.2 (1.4-3.1)	.01	0.6 (0.3-1.2)
Mexican American	12	1.6 (0.7-2.4)		0.6 (0.2-1.3)	16	2.3 (0.8-3.7)		0.4 (0.2-0.8)	17	2.2 (1.6-2.8)		0.7 (0.4-1.3)
Other	9	2.7 (0.7-4.6)		1.1 (0.5-2.5)	6	2.3 (0.0-5.1)		0.4 (0.1-1.5)	2	0.3 (0.0-0.7)		0.1 (0.0-0.5)
White, non-Hispanic	19	1.9 (1.2-2.7)		1 [Reference]	48	5.6 (3.6-7.6)		1 [Reference]	17	2.2 (1.1-3.4)		1 [Reference]
Poverty to income ratio												
First quintile	29	2.9 (1.4-4.5)	.25	3.1 (0.9-10.4)	22	5.1 (2.0-8.1)	.28	1.7 (0.7-4.1)	18	3.0 (1.1-4.8)	.11	3.1 (1.2-8.3)
Second quintile	14	3.3 (0.7-5.8)		3.6 (0.7-17.7)	15	2.8 (0.7-4.8)		0.8 (0.3-1.9)	17	3.5 (0.6-6.5)		3.4 (1.1-10.3)
Third quintile	14	2.9 (0.6-5.2)		3.2 (0.8-12.3)	17	3.8 (1.7-5.8)		1.0 (0.4-2.4)	9	1.9 (0.3-3.5)		1.7 (0.6-5.4)
Fourth quintile	8	1.6 (0.3-2.8)		1.7 (0.5-5.6)	23	6.6 (3.3-9.9)		1.7 (0.8-3.8)	3	0.9 (0.0-2.2)		0.8 (0.2-3.8)
Fifth quintile	6	0.9 (0.0-1.8)		1 [Reference]	16	4.2 (1.7-6.8)		1 [Reference]	6	1.2 (0.4-2.0)		1 [Reference]

Abbreviations: AOR, adjusted odds ratio (from model containing all variables shown in the table); CI, confidence interval.
[a] Met *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition) criteria.
[b] For between-group comparison of prevalence rates in χ^2 analysis.

Boys had an increased likelihood of meeting *DSM-IV* criteria for all ADHD subtypes compared with girls in bivariate analyses (ADHD-CT: 3.3% vs 1.0%, $P<.001$; ADHD-IA: 5.7% vs 3.1%, $P=.004$; ADHD-HI: 2.8% vs 1.2%, $P=.01$). In multivariable analyses, this pattern of male predominance was strongest for ADHD-CT (AOR vs girls, 3.2; 95% CI, 1.9-5.5) but was also significant for ADHD-IA (AOR vs girls, 1.8; 95% CI, 1.2-2.8) and ADHD-HI (AOR vs girls, 2.2; 95% CI, 1.1-4.5).

Younger children were observed to have higher ADHD-HI rates compared with older children (2.8% for 8- to 11-year-olds vs 1.3% for 12- to 15-year-olds; $P=.03$) in bivariate analyses, but this difference reached only borderline significance in multivariable analyses (AOR, 1.9; 95% CI, 0.9-3.9).

REPORTED PRIOR DIAGNOSIS AMONG CHILDREN MEETING *DSM-IV* ADHD CRITERIA

Among those meeting *DSM-IV* ADHD criteria during the past year, 47.9% (95% CI, 39.5%-56.2%) of caregivers reported that their child had received an ADHD diagnosis by a health professional. In bivariate analyses, significant predictors of prior ADHD recognition included non-Hispanic white race, male sex, older age, and receipt of health insurance (**Table 4**). Multivariable analyses confirmed male sex, older age, and health insurance receipt as predicting a greater likelihood of prior ADHD recognition ($P=.03$, $P<.001$, and $P=.002$, respectively), whereas race/ethnicity was no longer significant. Income and ADHD subtype were not associated with prior diagnosis among children meeting *DSM-IV* ADHD criteria.

MEDICATION USE AMONG CHILDREN MEETING *DSM-IV* ADHD CRITERIA

Of the children who met *DSM-IV* ADHD criteria, 38.8% (95% CI, 30.3%-47.3%) reportedly received medication to treat inattention, hyperactivity, or overactivity at any time in the prior year, and 32.0% (95% CI, 25.7%-38.3%) received medication for most of the past year (ie, consistent use). Child age was the only significant sociodemographic predictor of any ADHD medication use in the past year in multivariable analyses, with an increased likelihood of treatment for older children (**Table 5**). However, income was a significant predictor of consistent medication treatment. Among children meeting *DSM-IV* ADHD criteria, only 15.5% (95% CI, 5.5%-25.5%) of the poorest children (PIR, first quintile) had received ADHD medications for most of the previous year, with their likelihood of consistent medication receipt being less than one-third that of children in other income groups (Table 5). There was also a trend toward increased regular medication use in older children. Race/ethnicity was not associated with consistent ADHD medication use.

COMMENT

In a nationally representative sample of children aged 8 to 15 years, 8.7% met *DSM-IV* criteria for any type of ADHD in the year prior to the survey, equivalent to approximately 2.4 million children. We found a higher prevalence of meeting *DSM-IV* ADHD criteria in the poorest children, particularly for ADHD-HI. Mexican American children had lower overall rates of ADHD, and both Mexican Americans and African Americans had lower

rates of ADHD-IA. Despite rising public awareness of ADHD, less than half of children who met *DSM-IV* ADHD criteria had reportedly had their conditions diagnosed by a health care professional or been treated with medications. Girls were less likely to have their disorder recognized, and the poorest children were least likely to receive consistent ADHD medication treatment.

ADHD AND ADHD SUBTYPE PREVALENCE

Our estimate of overall ADHD prevalence is within the range of prior ADHD prevalence measurements in US regional studies using *DSM-IV* criteria (2.6%-11.4%).[15,16,20,27,30] However, the present study's use of a national sample allows increased generalizability and more precisely characterizes the magnitude of the disorder. In this sample, ADHD-IA was the most common ADHD subtype, a finding that concurs with 2 US regional and 2 international population-based studies of ADHD prevalence[16,27,33,47] but is in contrast to the results of 1 US regional[30] and 2 international population-based investigations.[34,35] Possible reasons for differences include parents' varying cultural expectations of behavioral norms or changes in media coverage increasing awareness of inattentive symptoms. The distribution of ADHD etiologic factors may also have varied, leading to true differences in subtype predominance.

ADHD PREVALENCE WITHIN SOCIODEMOGRAPHIC SUBGROUPS

The nation's poorest children had an increased likelihood of meeting *DSM-IV* ADHD criteria. This is consistent with the findings of 2 US regional population-based studies that used *DSM-III-R* criteria for outcome assessment.[21,24] In addition, we found higher rates of ADHD-HI in lower-income children, supporting the results of a prior clinical referral sample in which socioeconomic status was lowest for patients with ADHD-HI and highest for for those with ADHD-IA.[31] Because the findings of these *DSM*-based investigations were in regional, predominately non-Hispanic white communities or clinically referred samples, our nationally representative study improves understanding of the ADHD burden facing poor children across the United States. Reasons for the increased likelihood of ADHD in poorer children may include the elevated prevalence of ADHD risk factors (ie, premature birth[36] and in utero[38] or childhood exposures to toxic substances[37]) in this group. In addition, given the high heritability of ADHD[48] and its negative impact on social, academic, and career outcomes,[49] it is plausible that families with ADHD may cluster within the lower socioeconomic strata.

In accordance with 2 *DSM*-based investigations, we observed no significant difference in overall ADHD rates between non-Hispanic white children and African Africans,[21,30] although African Americans had lower rates of ADHD-IA. We also found that Mexican American children had half the likelihood of meeting *DSM-IV* criteria for any type of ADHD compared with non-Hispanic white children. Given the paucity of prior data, it is difficult to speculate on reasons for the lower ADHD rate observed in Mexican American children. Our findings may be due to differences in the prevalence of causal risk factors, genetic susceptibility, and/or rates of reporting ADHD symptoms across cultures.[29]

Table 4. Rates and Likelihood of Prior Diagnosis[a] Among Those With Attention-Deficit/Hyperactivity Disorder (All Types) by *DSM-IV* Criteria

Characteristic	No.	Weighted % (95% CI)	*P* Value[b]	AOR (95% CI)
Age, y				
8-11	38	32.6 (22.1-43.2)	<.001	1 [Reference]
12-15	56	67.1 (55.8-78.5)		4.5 (2.2-9.0)
Sex				
Male	70	54.6 (44.3-64.9)	.03	1 [Reference]
Female	24	33.0 (17.5-48.4)		0.3 (0.1-0.8)
Race/ethnicity				
White, non-Hispanic	47	51.3 (40.9-61.6)	.03	1 [Reference]
African American	27	36.5 (24.5-48.6)		0.8 (0.3-1.9)
Mexican American	11	25.9 (12.6-39.1)		0.5 (0.2-1.6)
Other	9	67.1 (34.0-100.0)		0.8 (0.2-3.3)
Poverty to income ratio				
First quintile	20	35.7 (12.7-58.8)	.43	1 [Reference]
Second quintile	21	49.2 (28.7-69.8)		2.6 (0.7-9.3)
Third quintile	17	44.9 (28.3-61.6)		1.6 (0.5-5.3)
Fourth quintile	21	62.3 (43.2-81.4)		3.3 (0.8-13.6)
Fifth quintile	15	52.6 (30.6-74.6)		1.6 (0.4-7.4)
Health insurance status				
Insured	92	51.5 (42.5-60.6)	.002	1 [Reference]
Not insured	2	16.4 (12.2-20.6)		0.1 (0.1-0.4)
ADHD subtype				
Combined	36	57.8 (45.8-69.7)	.36	1 [Reference]
Inattentive	36	47.4 (34.8-60.0)		0.7 (0.3-1.3)
Hyperactive-impulsive	22	39.1 (16.2-61.9)		0.8 (0.2-2.6)

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; AOR, adjusted odds ratio (from model containing all variable shown in the table); CI, confidence interval; *DSM-IV*, *Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition).
[a] Assessed via caregiver report.
[b] For between-group comparison of rates in χ^2 analysis.

REPORTED PRIOR DIAGNOSIS RATES AMONG CHILDREN WITH ADHD

We found that 48% of children meeting *DSM-IV* ADHD criteria had reportedly been diagnosed as having ADHD by a health care professional. Unlike prior national studies, in which African American race was associated with lower rates of reported ADHD diagnosis,[7,9] race/ethnicity did not predict prior recognition among those meeting ADHD *DSM-IV* criteria. In addition, income level and ADHD subtype were not associated with reported prior ADHD diagnosis among children meeting *DSM-IV* criteria, whereas older age (12-15 years old) and male sex did predict a prior diagnosis. Our results suggest a need for health care professionals to increase their index of suspicion regarding the likelihood of ADHD in girls.[50] Despite concerns that ADHD may be overlooked in patients from minority backgrounds[51] and those with ADHD-IA,[52] we did not find evidence of preferential underrecognition in these groups.

MEDICATION TREATMENT RATES AMONG CHILDREN WITH ADHD

Among children meeting *DSM-IV* ADHD criteria, 39% had some medication treatment and 32% had consistent medi-

Table 5. Rates and Likelihood of Medication Treatment Among Those With Attention-Deficit/Hyperactivity Disorder (All Types) by *DSM-IV* Criteria

Characteristic	Any Medication in the Past Year				Medication for Most of the Past Year			
	No.	Weighted % (95% CI)	*P* Value[a]	AOR (95% CI)	No.	Weighted % (95% CI)	*P* Value[a]	AOR (95% CI)
Age, y								
8-11	31	25.7 (15.4-36.0)	<.001	1 [Reference]	28	24.4 (14.6-34.2)	.01	1 [Reference]
12-15	48	55.0 (43.4-66.6)		3.6 (1.6-8.2)	37	41.4 (33.0-49.7)		2.0 (1.0-4.2)
Sex								
Male	58	44.0 (34.1-53.9)	.06	1 [Reference]	46	35.6 (27.3-43.9)	.19	1 [Reference]
Female	21	26.8 (11.7-42.0)		0.3 (0.1-1.1)	19	23.7 (10.1-37.3)		0.5 (0.1-1.5)
Race/ethnicity								
White, non-Hispanic	38	41.0 (29.5-52.5)	.05	1 [Reference]	31	33.2 (24.5-41.8)	.20	1 [Reference]
African American	23	28.1 (18.5-37.6)		0.7 (0.4-1.6)	20	24.7 (16.3-33.0)		0.9 (0.5-1.8)
Mexican American	9	21.8 (8.7-34.8)		0.6 (0.2-2.0)	8	19.3 (6.8-31.8)		0.7 (0.2-2.4)
Other	9	60.4 (28.2-92.6)		1.0 (0.2-4.4)	6	51.0 (13.0-89.0)		1.4 (0.3-6.1)
Poverty to income ratio								
First quintile	19	28.5 (8.1-48.9)	.59	1 [Reference]	14	15.5 (5.5-25.5)	.13	1 [Reference]
Second quintile	16	37.0 (19.9-54.1)		2.3 (0.8-6.7)	13	33.2 (16.0-50.4)		3.9 (1.3-11.8)
Third quintile	18	48.0 (30.8-65.3)		2.9 (0.9-9.0)	15	42.2 (24.1-60.2)		5.0 (1.6-15.2)
Fourth quintile	15	44.6 (25.8-63.5)		1.8 (0.6-5.6)	12	35.4 (18.9-52.0)		3.1 (1.1-9.0)
Fifth quintile	11	40.3 (22.1-58.5)		1.3 (0.4-4.8)	11	40.3 (22.1-58.5)		3.4 (1.3-9.1)
Health insurance status								
Insured	79	43.2 (34.4-52.0)	ND[b]	1 [Reference]	65	35.6 (29.0-42.1)	ND[b]	1 [Reference]
Not insured	0	ND[b]		ND[b]	0	ND[b]		ND[b]
ADHD subtype								
Combined	34	51.0 (37.0-65.1)	.12	1 [Reference]	27	41.3 (27.4-55.2)	.29	1 [Reference]
Inattentive	28	38.5 (24.0-53.0)		0.6 (0.3-1.3)	23	30.8 (20.1-41.4)		0.7 (0.3-1.3)
Hyperactive-impulsive	17	26.2 (10.9-41.5)		0.5 (0.2-1.6)	15	24.4 (9.6-39.1)		0.7 (0.2-2.4)

Abbreviations: ADHD, attention-deficit/hyperactivity disorder; AOR, adjusted odds ratio (from model containing all variables shown in the table, including health insurance); CI, confidence interval; *DSM-IV, Diagnostic and Statistical Manual of Mental Disorders* (Fourth Edition); ND, not determined.

[a] For between-group comparison of rates in χ^2 analysis.

[b] Could not be determined because no uninsured participants were treated with ADHD medications. When health insurance was removed to determine whether its inclusion altered model stability, results were not substantively changed.

cation treatment during the past year. To our knowledge, only a few prior population-based studies, conducted in single-site[15,28] or multisite[29] samples, have reported on treatment received by children with ADHD using a *DSM*-diagnosed sample. Rates of ADHD medication treatment among those meeting *DSM-IV* ADHD criteria were higher in our study than those observed by Jensen et al (12% for use in the previous 12 months)[29] and Wolraich et al (15%-27% for current medication use)[15] but lower than rates documented by Angold et al (72% for any use during a 4-year period).[28] These differences may be due to variations in regional prescribing practices or to differing time frames for outcome assessment.

Although prior national studies found no disparity in medication treatment rates by income,[3,41] we found that among children fulfilling *DSM-IV* ADHD criteria, the poorest children were 3 to 5 times less likely to receive consistent medication treatment compared with other income groups. In a prior regional study using a *DSM-III-R*–based assessment for ADHD, income-related differences were not observed for the likelihood of any ADHD pharmacotherapy during a multiyear span.[28] However, because the prior study did not comment on the duration and regularity of medication treatment by subgroup, a comparison is not available for our findings regarding consistent ADHD medication treatment. Although prior national studies found that racial/ethnic minority populations are less likely to use ADHD medications compared with non-Hispanic white children,[3,5] we found no significant racial/ethnic group differences in the likelihood of pharmacotherapy among those with *DSM-IV*–defined ADHD.

LIMITATIONS

One limitation relates to how the ADHD diagnosis was derived for this study. The American Academy of Pediatrics recommends that both caregiver and teacher reports be used to inform a clinical diagnostic evaluation for ADHD.[52] However, *DSM-IV* criteria state simply that impairment must exist in 2 or more settings and do not specifically require 2 reporters.[12] The NHANES used only the DISC caregiver module for ADHD assessment, a structured diagnostic interview designed for use in large-scale epidemiologic surveys.[43] Notably, the DISC interview assesses symptom pervasiveness by asking caregivers to report symptoms and impairment at home and at school or other activities.[12] To our knowledge, no prior US population-based studies using *DSM-IV* ADHD criteria have gathered clinical data from both caregivers and teachers.[15,16,20,27,30] Nonetheless, lower overall rates of ADHD and different subtype rates may result when reports from both teachers and parents are available.[53,54]

Another potential limitation pertains to the influence of cultural behavioral norms on caregiver symptom reports, as sociodemographic differences in prevalence

may be partially due to culturally divergent ratings of ADHD symptoms.[55] In addition, circumstances are difficult to interpret for the 3.3% of children who had a reported diagnosis of ADHD and were receiving medication but did not meet *DSM-IV* ADHD criteria. The NHANES' cross-sectional design does not allow us to distinguish those who intially met *DSM-IV* criteria but whose symptoms were reduced below the threshold by medication from those who were prescribed medication inappropriately. Therefore, these 3.3% were not included in our overall ADHD prevalence measurement, a factor that may make our estimate of 8.7% a conservative approximation. Missing data could also have altered the observed prevalence rates. However, given that the analyses incorporated sample weights accounting for differential nonresponse, bias due to this factor is minimized. Furthermore, although this study is of substantial dimension, sample size was still limited for sociodemographic subgroup analyses, particularly for ADHD subtype prevalence.

Finally, our medication treatment outcome was assessed via parent report, whereas review of medical or pharmacy records would have been preferable. In addition, although we are able to determine the prevalence of reported pharmacotherapy in children with *DSM-IV*–defined ADHD and its variation across sociodemographic groups during the year prior to the survey, we cannot comment on reasons for the rates or differences observed. Although there are often compelling reasons to try stimulant medication treatment in children with ADHD, including robust data confirming short-term symptom improvement, reduced impairment, and protection against future adverse outcomes such as substance abuse,[56,57] stimulant medications are sometimes discontinued owing to lack of efficacy or or unacceptable adverse effects.[58] Because the NHANES does not contain information about lifetime ADHD medication treatment, we are unable to differentiate children who never tried ADHD medications from those who did not continue because of ineffectiveness or adverse effects. Finally, although behavioral interventions for ADHD are important, the NHANES does not contain specific information about nonpharmacologic treatments for attentional problems.

CONCLUSIONS

We found *DSM-IV*–diagnosed ADHD to be prevalent in American children and more common among the poorest children. Children from minority backgrounds had lower rates of ADHD-IA, whereas the poorest children had an increased likelihood of ADHD-HI. If this study is replicated, etiologic factors that may partially explain these differences—such as varying rates of in utero tobacco exposure, childhood lead exposure, and complications of pregnancy and delivery—should be investigated so that future public health efforts can be directed at preventing ADHD in groups at highest risk. We also observed that less than half of children who met *DSM-IV* criteria for ADHD had reportedly had their conditions diagnosed or been treated with ADHD medications, suggesting that some children with clinically significant inattention and hyperactivity may not be receiving optimal interventions. Finally, our finding of a lower likelihood of consistent medication use in the poorest children warrants further investigation and possible intervention to ensure that all children with ADHD have equitable access to treatment when appropriate.

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