

Trends in the Parent-Report of Health Care Provider-Diagnosed and Medicated Attention-Deficit/Hyperactivity Disorder: United States, 2003–2011

Susanna N. Visser, MS, Melissa L. Danielson, MSPH, Rebecca H. Bitsko, PhD, Joseph R. Holbrook, PhD, Michael D. Kogan, PhD, Reem M. Ghandour, DrPH, Ruth Perou, PhD, Stephen J. Blumberg, PhD

Objective: Data from the 2003 and 2007 National Survey of Children's Health (NSCH) reflect the increasing prevalence of parent-reported attention-deficit/hyperactivity disorder (ADHD) diagnosis and treatment by health care providers. This report updates these prevalence estimates for 2011 and describes temporal trends. **Method:** Weighted analyses were conducted with 2011 NSCH data to estimate prevalence of parent-reported ADHD diagnosis, current ADHD, current medication treatment, ADHD severity, and mean age of diagnosis for U.S. children/adolescents aged 4 to 17 years and among demographic subgroups. A history of ADHD diagnosis (2003–2011), as well as current ADHD and medication treatment prevalence (2007–2011), were compared using prevalence ratios and 95% confidence intervals. **Results:** In 2011, 11% of children/adolescents aged 4 to 17 years had ever received an ADHD diagnosis (6.4 million children). Among those with a history of ADHD diagnosis, 83% were reported as currently having ADHD (8.8%); 69% of children with current ADHD were taking medication for ADHD (6.1%, 3.5 million children). A parent-reported history of ADHD increased by 42% from 2003 to 2011. Prevalence of a history of ADHD, current ADHD, medicated ADHD, and moderate/severe ADHD increased significantly from 2007 estimates. Prevalence of medicated ADHD increased by 28% from 2007 to 2011. **Conclusions:** Approximately 2 million more U.S. children/adolescents aged 4 to 17 years had been diagnosed with ADHD in 2011, compared to 2003. More than two-thirds of those with current ADHD were taking medication for treatment in 2011. This suggests an increasing burden of ADHD on the U.S. health care system. Efforts to further understand ADHD diagnostic and treatment patterns are warranted. *J. Am. Acad. Child Adolesc. Psychiatry*, 2014;53(1):34–46. **Key Words:** attention-deficit/hyperactivity disorder (ADHD), epidemiology, medication, prevalence, stimulants

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder with childhood onset.¹ Children with ADHD experience clinically significant functional

impairment across settings (for example at home, in school, and with friends), resulting in higher rates of unintentional injury, emergency room visits, peer problems, and academic failure.^{2–7} Approximately one-third of children diagnosed with ADHD retain the diagnosis into adulthood, supporting the recognition of ADHD as a chronic health condition.⁸

Best practices for diagnosing and treating ADHD exist and include conducting a clinical diagnostic evaluation, incorporating information from multiple respondents (e.g., parents, child,



This article is discussed in an editorial by Dr. John T. Walkup on page 14.



Clinical guidance is available at the end of this article.



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teachers, child care staff) and across multiple settings (e.g., home, school, child care), and evaluating the child for co-occurring conditions.^{9,10} ADHD medication has long been used to effectively treat ADHD symptoms of impulsivity, inattention, and hyperactivity and is the single-most effective treatment for reducing ADHD symptoms.^{11,12} High-quality behavioral interventions can also improve functional outcomes of selected children with ADHD^{13,14}, but may not be as broadly available across the U.S.

Characterizing the evolving epidemiology of ADHD diagnosis and treatment informs the public health impact of diagnosis and treatment within communities, allows tracking changes over time, informs service use and needs, and provides a context for interpreting the impact of health alerts extending from adverse event reporting systems.¹⁵⁻¹⁸ Population-based epidemiological estimates of ADHD can come from a variety of sources. Analyses of insurance claims data have documented steady increases in the prevalence of ambulatory visits for ADHD diagnoses between 2001 and 2010^{19,20}; however, studies based on claims data are not necessarily representative of the uninsured or underinsured. A recent, large-scale community-based study from 4 school districts across 2 states suggests that the prevalence among elementary-aged children is 9% to 11%²¹; a large, national direct assessment of children 13 to 17 years of age suggested that the lifetime prevalence of ADHD among adolescents was 8.7%.²² However, direct assessment of children in communities is resource intensive, and it is not an efficient method for monitoring prevalence over time. Large-scale surveys of parents that ask about clinician-diagnosed conditions provide an important cross-sectional picture of the impact of disorders, including ADHD, and can be repeated over time for surveillance purposes. Parent surveys can also be used to estimate both national and state-based prevalence of conditions.

Since 1996, parent reports of health care provider-diagnosed ADHD in childhood have been collected by nationally representative health surveys, beginning with the National Health Interview Survey (NHIS).²³ The reports of a diagnosis by a health care provider is a proxy for underlying ADHD, asking parents "Has a doctor or other health care provider ever told you that your child had attention deficit disorder (ADD) or attention-deficit/hyperactivity disorder (ADHD)?" This report of an ADHD diagnosis

was included in the 2003, 2007, and 2011 National Survey of Children's Health (NSCH), which is a periodic parent survey of the physical and emotional health of US children, 0 to 17 years of age.^{24,25,30} Increases in parent-reported ADHD diagnosis and medication treatment have been documented using data from NHIS and NSCH; average annual increases in parent-reported ADHD diagnosis ranged from 3% to 6% per year since the late 1990s.²⁶⁻²⁸

Based on data from the 2007 NSCH, an estimated 9.5% of children/adolescents 4 to 17 years of age had been diagnosed with ADHD; 78% of those children were characterized by their parents as having current ADHD, representing 7.2% (4.1 million) of school-aged children.²⁸ The estimated prevalence increased by 22% from 2003 to 2007, with an average annual increase of 5.5% per year from 2003 to 2007. Increases in prevalence were greatest among groups with historically lower rates of ADHD: older teens, Hispanics, and children who spoke a primary language other than English. Two-thirds of those with current ADHD were taking medication in 2007. ADHD medication treatment increased with ADHD severity. Nearly 1 in 20 (4.8%) of U.S. children/adolescents 4 to 17 years of age (2.7 million individuals) were taking ADHD medication in 2007, which is consistent with a 2008 Medical Expenditure Panel Survey estimate of 5.1% among children 6 to 12 years of age.²⁹

Data from the most recent NSCH allow updated estimates of parent-reported ADHD diagnosis and treatment, as well as inspection of trends in these estimates over time. Based on previous reports, average annual growth rates of 3% to 6% for parent-reported ADHD diagnosis and a commensurate increase in parent-reported ADHD medication treatment were expected.

METHOD

The NSCH is a national cross-sectional, random-digit-dialed telephone survey conducted in 2003 to 2004 (designated as "2003"), 2007 to 2008 ("2007"), and 2011-2012 ("2011").^{24,25,30} The NSCH uses the sampling frame of the National Immunization Survey³¹; because of the rise in the prevalence of cell-phone-only households, the 2011 NSCH added a sample of cell-phone numbers. Between February 2011 and June 2012, 95,677 interviews were completed, resulting in landline and cell-phone interview completion rates of 54.1% and 41.2%, respectively, and a 23.0% overall response rate.³⁰ Sample weights were used to adjust for unequal probability of selection of households

and children, nonresponse, and the underlying demographic distribution of U.S. noninstitutionalized children. The survey questions pertaining to ADHD diagnosis and treatment are included as a supplement to this article (Table S1, available online). A responding parent or guardian (referred to hereafter as "parent") was asked questions about 1 randomly selected child (aged 0–17 years) in the household. Analyses were conducted in SAS-callable SUDAAN version 11.0 (RTI International; Cary, NC) to account for the complex survey design and application of sample weights.

At all 3 time points, parents were asked if "a doctor or other health care provider ever told you that [child] had attention deficit disorder or attention-deficit/hyperactivity disorder, that is, ADD or ADHD." In 2007 and 2011, parents who reported a history of ADHD were asked whether the child currently had ADHD, and, in 2011, they were asked the age at which the diagnosis was made. Parents reporting current ADHD also described the severity of ADHD (mild, moderate, or severe). In each survey year, a question was included asking about current medication treatment for ADHD; however, a different subset of parents were asked this question in 2003 as compared to subsequent surveys. In 2003, parents who reported that their child had ever received a diagnosis were asked about current medication treatment, whereas in 2007 and 2011, only parents reporting current ADHD were asked about current medication treatment; this prohibited direct comparisons of medication for ADHD across the 3 surveys. Data allowed direct comparisons of ever-diagnosed ADHD (2003–2011), current ADHD (2007–2011), ADHD severity (2007–2011), and current medication for ADHD (2007–2011). Independent of ADHD diagnosis, all parents were asked if their child had received treatment or counseling from a mental health professional in the past 12 months.

Data Analysis

For the 2011 survey data, estimated prevalence of a history of parent-reported ADHD diagnosis (ever diagnosed), current ADHD, and current medication treatment were calculated for children/adolescents aged 4 to 17 years and compared across demographic subgroups using prevalence ratios (PRs). The mean age of diagnosis was calculated overall and contrasted with severity using a Wald F test.

The demographic groups and subgroups were comparable to those used in the previous reports describing the 2003 and 2007 data,^{28,32} to allow direct comparison of the estimates over time. Estimated prevalence of ever-diagnosed ADHD in 2011 was compared to 2003 and 2007 NSCH estimates using PRs; differences in rate of change over time was tested with a Wald F test comparing the combination of yearly indicator regression coefficients. Estimates of current ADHD and current medication treatment from 2011 were compared to 2007 using PRs and 95% CI. Demographic subgroup differences for change over

time were tested by a Wald F test on an interaction term. Parent-report of treatment or counseling by a mental health professional was combined with medication treatment to estimate ADHD treatment prevalence among children with current ADHD; the percentage of those with a current ADHD diagnosis reported to be in treatment was compared between 2007 and 2011.

RESULTS

All ADHD survey indicators extended from parent-reported data for children/adolescents aged 4 to 17 years; for brevity, the term "parent-reported" and age (4–17 years) is excluded as a qualifier of the relevant estimates that follow.

2011 Ever-Diagnosed and Current ADHD Prevalence Estimates and Demographic Patterns

In 2011, the estimated prevalence of ever-diagnosed ADHD among children was 11.0%, representing 6.4 million children nationwide (Table 1). Among children with ever-diagnosed ADHD, 82.3% had current ADHD resulting in an estimated national prevalence of 8.8% among children (5.1 million nationwide).

ADHD diagnosis (ever and current) was significantly associated ($p < .05$ based on χ^2 statistics) with every demographic indicator studied. Ever-diagnosed ADHD was higher among boys (15.1%) than girls (6.7%) and increased with age (Table 1). The highest point estimates were among boys (15.1%), children 11 and older (11–14 years: 14.3%, 15–17 years: 14.0%), and children with public health care coverage (14.4%). Prevalence was higher for black and white children compared to those of other races; the prevalence among Hispanics was half that of non-Hispanics. Those living in households where English was the primary language were more than 4 times as likely to have been diagnosed with ADHD as those living in households speaking another primary language. Prevalence was highest among children from households with 12 years (high school graduate) of education, compared to households with more or less education. Children living below 200% of the federal poverty level had a higher prevalence than children from higher-income families. Ever-diagnosed ADHD was more common among children with health care coverage than those without coverage, and among those with public coverage than with private coverage. Ever-diagnosed ADHD was lowest in the West, compared to other U.S. regions.

The demographic and state-based patterns for current ADHD were generally consistent with

TABLE 1 Weighted Prevalence Estimates of Parent-Reported Attention-Deficit/Hyperactivity Disorder (ADHD) Diagnosis by a Health Care Provider Among Children Aged 4–17 Years by Sociodemographic Characteristics (National Survey of Children’s Health, United States, 2011)

Characteristic	n	Ever Diagnosed with ADHD n = 76,015 respondents			Current ADHD n = 75,840 respondents			Current ADHD and Current Medication for ADHD n = 75,828 respondents		
		%	95% CI	PR	%	95% CI	PR	%	95% CI	PR
Overall	76,015	11.0	10.5–11.5		8.8	8.4–9.3		6.1	5.7–6.5	
Sex										
Male	39,314	15.1	14.3–15.9	2.24	12.1	11.4–12.8	2.19	8.4	7.9–9.1	2.31
Female	36,701	6.7	6.2–7.3	1.00	5.5	5.0–6.0	1.00	3.7	3.3–4.1	1.00
Age										
4–10 years of age	36,219	7.7	7.2–8.3	1.00	6.8	6.2–7.4	1.00	4.9	4.5–5.4	1.00
11–14 years of age	21,409	14.3	13.3–15.4	1.85	11.4	10.5–12.4	1.69	8.0	7.2–8.8	1.63
15–17 years of age	18,387	14.0	12.9–15.2	1.81	10.2	9.2–11.3	1.51	6.5	5.7–7.3	1.32
Highest Educ. in Household										
<HS	4,453	8.5	7.2–9.9	0.78	6.9	5.7–8.2	0.79	4.2	3.4–5.2	0.70
12 years, HS graduate	11,569	13.3	12.1–14.6	1.23	11.0	9.9–12.2	1.27	7.7	6.8–8.8	1.29
>HS	58,550	10.8	10.3–11.4	1.00	8.6	8.1–9.2	1.00	6.0	5.6–6.4	1.00
Race										
White	54,927	12.2	11.5–12.8	1.00	9.8	9.2–10.4	1.00	7.1	6.6–7.6	1.00
Black	7,615	11.9	10.6–13.4	0.98 ^a	9.5	8.3–10.9	0.98 ^a	5.7	4.8–6.7	0.80
Other	11,450	7.2	6.3–8.1	0.59	5.8	5.1–6.7	0.60	3.5	2.9–4.3	0.50
Ethnicity										
Hispanic/Latino	9,676	6.9	5.9–8.1	0.56	5.5	4.6–6.6	0.56	3.1	2.5–3.9	0.44
Non-Hispanic/Latino	64,799	12.3	11.8–12.9	1.00	9.9	9.4–10.4	1.00	7.0	6.6–7.5	1.00
Primary Language in Home										
English	70,522	12.4	11.9–13.0	1.00	10.0	9.5–10.5	1.00	7.0	6.6–7.4	1.00
Any other language	5,455	2.7	1.9–3.7	0.21	2.0	1.3–3.0	0.20	1.0	0.6–1.6	0.14
Federal Poverty Level ^b										
≤100	10,974	12.9	11.7–14.2	1.30	10.9	9.8–12.1	1.38	6.9	6.0–7.8	1.22
>100 to ≤200	13,500	11.8	10.7–12.9	1.18	9.4	8.4–10.5	1.19	6.6	5.8–7.5	1.16 ^a
>200	51,541	10.0	9.4–10.6	1.00	7.9	7.3–8.5	1.00	5.6	5.2–6.1	1.00
Any Health Care Coverage										
Yes ^c	72,525	11.3	10.8–11.8		9.2	8.7–9.6		6.3	6.0–6.7	
Medicaid/SCHIP (public)	20,313	14.4	13.5–15.4	1.53	11.9	11.0–12.9	1.58	8.1	7.4–8.9	1.52
Non-Medicaid (private)	51,440	9.4	8.9–10.0	1.00	7.5	7.0–8.1	1.00	5.3	4.9–5.8	1.00
No	3,380	6.4	5.0–8.2	0.68	4.1	3.0–5.5	0.54	2.3	1.4–3.7	0.42
Region										
Northeast	13,620	10.1	9.2–11.2	1.26	8.1	7.2–9.1	1.27	5.4	4.7–6.2	1.42
Midwest	17,870	12.1	11.3–13.0	1.50	10.0	9.3–10.8	1.57	7.1	6.5–7.8	1.88
South	25,327	12.6	11.8–13.4	1.56	10.1	9.3–10.9	1.58	7.3	6.7–8.0	1.94
West	19,198	8.1	7.0–9.3	1.00	6.4	5.4–7.5	1.00	3.8	3.1–4.6	1.00

Note: HS = high school; PR = prevalence ratio; SCHIP = State Children’s Health Insurance Program.
^aPR not significant at the level of $\alpha = 0.05$.
^bIncludes multiply imputed values for 9.4% of sample for which household income was missing.
^cPrevalence ratio not shown because referent group is a subset of the population of children with any health insurance.

those observed for ever-diagnosed ADHD, although current ADHD estimates were approximately 20% to 25% lower than ever-diagnosed estimates (Table 1). State-based estimates of current ADHD ranged from 4.2% in Nevada to 14.6% in Arkansas and 14.8% in Kentucky (Figure 1).

Among children with current ADHD, the median age of diagnosis was 6.2 years (95% CI = 6.0–6.4; mean = 7.0, 95% CI = 6.9–7.2). Age of diagnosis decreased with severity; children whose parents reported the child’s ADHD as “mild” were diagnosed at a median age of 7.0

years (95% CI = 6.8–7.3; mean = 7.8, 95% CI = 7.5–8.1), compared to 6.1 (95% CI = 5.8–6.3; mean = 6.9, 95% CI = 6.7–7.1) and 4.4 (95% CI = 4.1–4.7; mean = 5.2, 95% CI = 4.9–5.5) years for those with “moderate” and “severe” ADHD, respectively.

2011 Medication Treatment for Current ADHD

Estimated prevalence of medication treatment for ADHD among US children was 6.1% (3.5 million nationwide). Of those with a current ADHD diagnosis, 69.0% were taking ADHD medication. ADHD medication treatment estimates were significantly associated with every demographic indicator studied ($p < 0.05$ by χ^2 statistics). The highest point estimates of parent-reported ADHD medication treatment were observed among boys (8.4%), whites (7.1%), non-Hispanics (7.0%), children living in households speaking English as the primary language (7.0%), children with public health care coverage (8.1%), and children living in the Midwest (7.1%) and South (7.3%) (Table 1). After increasing with age from 4 to 10 years to 11 to 14 years, current medication treatment prevalence decreased slightly among adolescents 15 to 17 years

of age. Current medication treatment was lowest among children in households speaking a primary language other than English (1.0%). State-based estimates ranged from 2.0% in Nevada to 10.1% in Kentucky and 10.4% in Louisiana (Figure 2).

The proportion of children taking medication for ADHD increased with ADHD severity: 59.6% (95% CI = 55.6–63.5) for “mild” ADHD, 73.3% (95% CI = 69.2–77.0) for “moderate” ADHD, and 82.4% (95% CI = 76.0–87.3) for “severe” ADHD. The percentage of children with current ADHD who received any treatment or counseling from a mental health professional was 51.1% (95% CI = 48.4–53.7). The percentage of children receiving either medication for ADHD or mental health treatment was 82.5% (95% CI = 80.5–84.4).

Trends in Parent-Reported ADHD Indicators Over Time

Ever-Diagnosed and Current ADHD. Estimated prevalence of ever-diagnosed ADHD was 7.8%, 9.5%, and 11% in 2003, 2007, and 2011, respectively (Table 2). These estimates increased by 22% from 2003 to 2007 (average annual increase = 6%²⁸) and 16% from 2007 to 2011 (average annual

FIGURE 1 Weighted prevalence estimates of parent-reported current attention-deficit/hyperactivity disorder (ADHD) among children/adolescents 4 to 17 years of age, by state (United States, 2011).

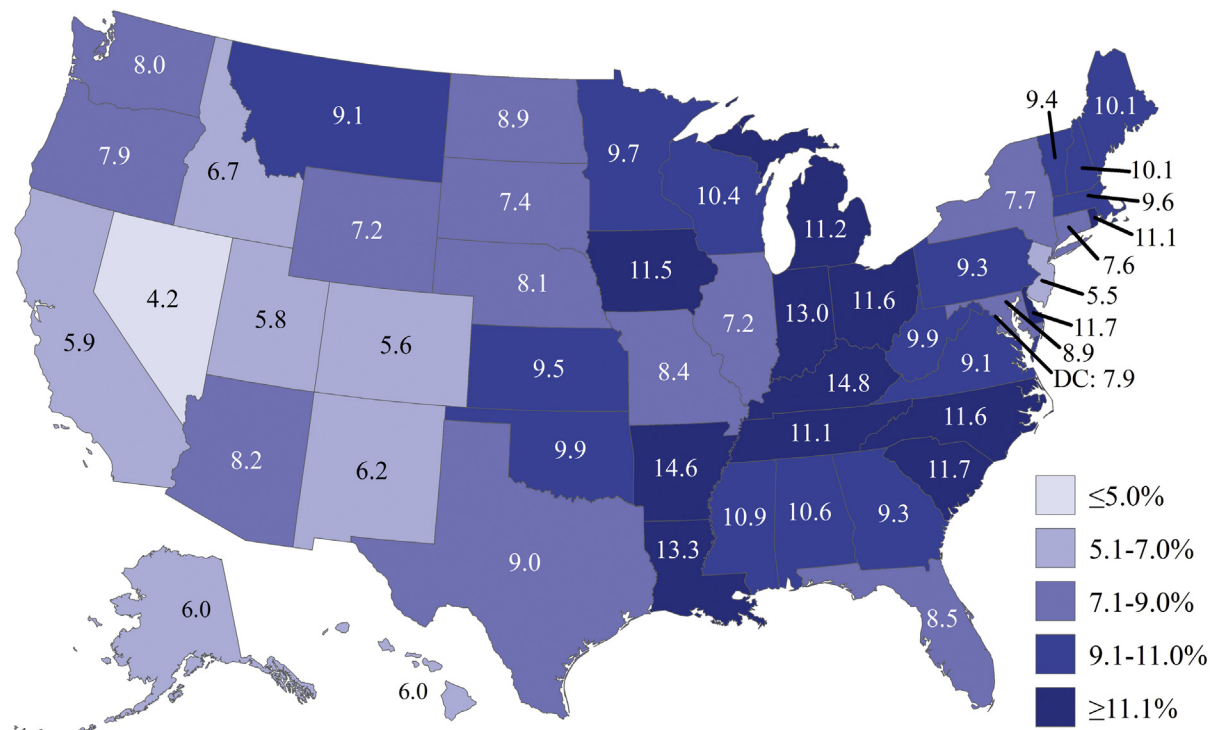
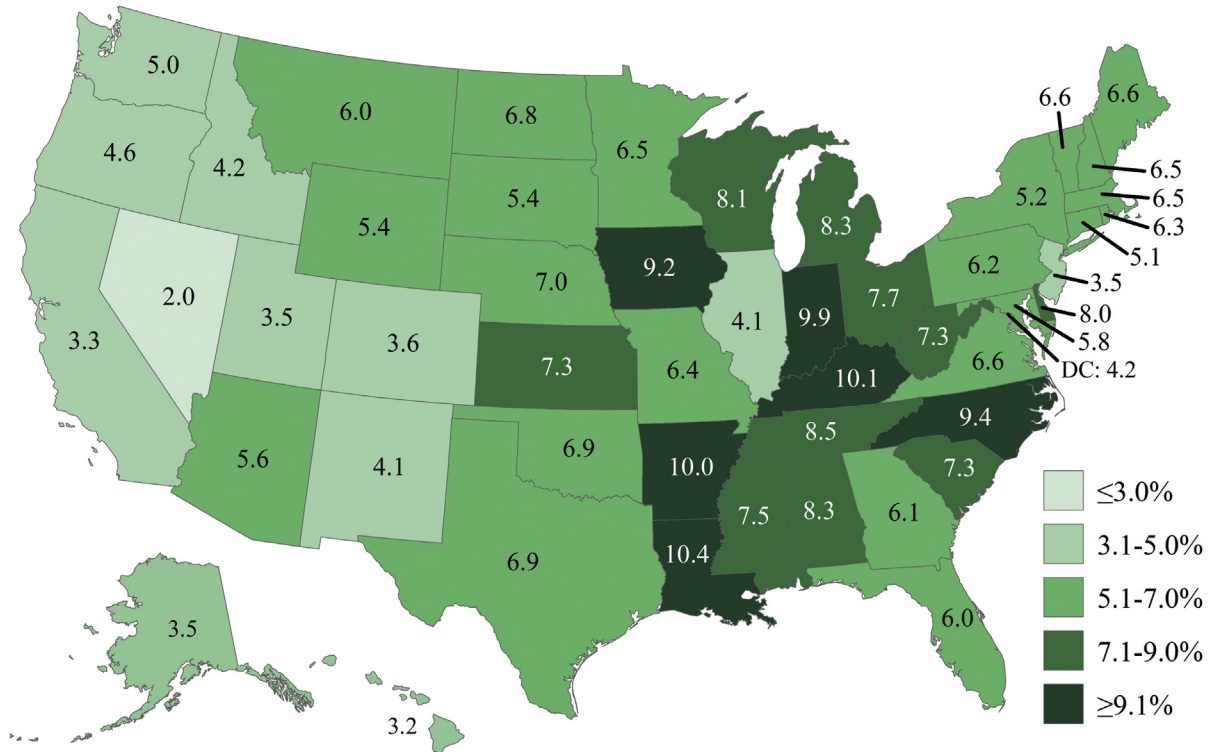


FIGURE 2 Weighted prevalence estimates of parent-reported current attention-deficit/hyperactivity disorder (ADHD) medication treatment among children/adolescents 4 to 17 years of age, by state (United States, 2011).



increase = 4%). The total increase from 2003–2011 was 42% (PR = 1.42, 95% CI = 1.33–1.50; average annual increase = 5%). The only 2 demographic subgroups for which there was not a significant change in ever-diagnosed ADHD from 2003 to 2011 were multiracial/other race children and children without health care coverage. The magnitudes of increase (slopes) from 2003 to 2007 and from 2007 to 2011 were equivalent for every subgroup studied, with the exception of the subgroup of 15- to 17-year-olds ($F_{1,57579} = 7.0, p < .01$), those living in households where the highest level of education was high school ($F_{1,39957} = 4.05, p < .05$) and children who were multiracial or of other races ($F_{1,24867} = 7.3, p < .01$), in which the magnitudes of increase were smaller for 2007 to 2011 than for 2003 to 2007. The greatest relative increases in ever-diagnosed ADHD from 2007 to 2011 were among children and adolescents aged 11 to 14 years, children living in a household with an adult with more than a high school education, whites, and children living in the Midwest. The pattern in the proportion of children with ever-diagnosed ADHD differed over time as a function of age ($F_{4,228249} = 2.57,$

$p < .05$); ever-diagnosed ADHD increased from 2003 to 2011 for children 14 and under, but the growth leveled off for older children from 2007 to 2011 (Table 2).

Current ADHD increased by 23%, from 7.2% to 8.8% from 2007 to 2011 (Table 2). The increases were reflected in significantly higher 2011 prevalence among children less than 14 years of age, children from households with at least 12 years of education, whites, non-Hispanics, children living in households where English was a primary language, those living in households with incomes above 100% of poverty, children with health care coverage, and children living in the Midwest and South; the greatest relative increases were seen among girls, children and adolescents 11 to 14 years of age, whites, and children living in the Midwest. Prevalence was statistically similar between 2007 and 2011 among those with public health care coverage, but increased significantly among children with private health care coverage. The increase in prevalence of current ADHD among Hispanics did not reach statistical significance ($p = .06$). The proportion of children with current ADHD

TABLE 2 Weighted Prevalence Estimates of Parent-Reported Attention-Deficit/Hyperactivity Disorder (ADHD) Diagnosis by a Health Care Provider Among Children/Adolescents Aged 4 to 17 Years^a by Sociodemographic Characteristics (National Survey of Children's Health, United States, 2003, 2007, and 2011)

	Ever Diagnosed with ADHD							Current ADHD				Current ADHD and Current Medication for ADHD			
	2003	2007	2011	2003–2011		2007–2011		2007	2011	2007–2011		2007	2011	2007–2011	
	%	%	%	PR	95% CI	PR	95% CI	%	%	PR	95% CI	%	%	PR	95% CI
Overall	7.8	9.5	11.0	1.42	1.33–1.50	1.16	1.08–1.24	7.2	8.8	1.23	1.13–1.33	4.8	6.1	1.28	1.16–1.41
Sex															
Male	11.0	13.2	15.1	1.37	1.28–1.48	1.15	1.06–1.24	10.3	12.1	1.17	1.07–1.29	6.9	8.4	1.22	1.09–1.36
Female	4.4	5.6	6.7	1.52	1.36–1.71	1.19	1.04–1.37	4.0	5.5	1.38	1.19–1.59	2.5	3.7	1.46	1.24–1.72
Age															
4–10 y	5.7	6.6	7.7	1.35	1.22–1.50	1.17	1.03–1.31	5.5	6.8	1.24	1.09–1.41	3.7	4.9	1.33	1.15–1.55
11–14 y	9.8	11.2	14.3	1.46	1.32–1.61	1.28	1.14–1.43	8.6	11.4	1.33	1.17–1.51	6.3	8.0	1.26	1.08–1.47
15–17 y	9.6	13.6	14.0	1.46	1.31–1.63	1.03	0.91–1.17	9.3	10.2	1.10	0.94–1.29	5.2	6.5	1.24	1.02–1.50
Highest Education in Household															
<HS	6.5	8.4	8.5	1.31	1.02–1.69	1.01	0.80–1.29	6.5	6.9	1.06	0.80–1.40	4.0	4.2	1.06	0.74–1.50
12 Years, HS Graduate	8.6	12.2	13.3	1.55	1.37–1.75	1.09	0.94–1.26	9.0	11.0	1.22	1.03–1.43	5.9	7.7	1.30	1.07–1.57
>HS	7.6	8.7	10.8	1.43	1.33–1.54	1.24	1.14–1.35	6.7	8.6	1.29	1.17–1.42	4.5	6.0	1.32	1.18–1.48
Race															
White	8.6	9.9	12.2	1.42	1.32–1.52	1.23	1.14–1.34	7.5	9.8	1.31	1.19–1.43	5.2	7.1	1.37	1.23–1.52
Black	7.7	10.1	11.9	1.54	1.30–1.83	1.18	0.99–1.40	7.8	9.5	1.22	0.99–1.50	5.1	5.7	1.12	0.86–1.45
Other	6.6	9.2	7.2	1.09	0.86–1.37	0.78	0.63–0.97	7.2	5.8	0.81	0.64–1.04	4.4	3.5	0.81	0.59–1.11
Ethnicity															
Hispanic/Latino	3.7	5.6	6.9	1.88	1.48–2.38	1.22	0.94–1.60	4.1	5.5	1.33	0.99–1.81	2.4	3.1	1.32	0.90–1.93
Non-Hispanic/Latino	8.6	10.5	12.3	1.43	1.35–1.52	1.18	1.10–1.26	8.0	9.9	1.24	1.15–1.35	5.4	7.0	1.30	1.18–1.43
Primary Language in Home															
English	8.6	10.5	12.4	1.44	1.35–1.53	1.18	1.10–1.27	8.0	10.0	1.26	1.16–1.36	5.3	7.0	1.31	1.19–1.44
Any other language	1.3	2.3	2.7	2.10	1.33–3.33	1.15	0.72–1.85	1.8	2.0	1.10	0.61–1.97	0.9	1.0	1.08	0.49–2.38
Federal Poverty Level ^b															
≤100	9.3	11.6	12.9	1.39	1.21–1.61	1.11	0.96–1.29	9.2	10.9	1.18	1.00–1.39	6.3	6.9	1.09	0.88–1.34
>100 to ≤200	7.9	10.3	11.8	1.49	1.31–1.70	1.14	0.97–1.33	7.7	9.4	1.22	1.03–1.46	4.7	6.6	1.40	1.14–1.71
>200	7.3	8.6	10.0	1.37	1.27–1.48	1.16	1.06–1.28	6.5	7.9	1.22	1.09–1.36	4.4	5.6	1.29	1.14–1.47
Any Health Care Coverage															
Yes	8.1	9.8	11.3	1.40	1.32–1.49	1.15	1.07–1.24	7.6	9.2	1.21	1.11–1.31	5.1	6.3	1.25	1.13–1.37
Medicaid/SCHIP (public)	10.8	13.6	14.4	1.33	1.21–1.47	1.06	0.95–1.18	10.9	11.9	1.10	0.97–1.24	7.5	8.1	1.08	0.93–1.25
Non-Medicaid (private)	6.9	8.1	9.4	1.36	1.25–1.47	1.17	1.06–1.28	6.1	7.5	1.23	1.10–1.37	4.1	5.3	1.31	1.15–1.48
No	4.9	6.7	6.4	1.32	0.96–1.81	0.96	0.67–1.37	3.7	4.1	1.11	0.74–1.65	1.7	2.3	1.32	0.72–2.43

TABLE 2 Continued

Region	Ever Diagnosed with ADHD						Current ADHD						Current ADHD and Current Medication for ADHD					
	2003		2007		2011		2003-2011		2007-2011		2011		2007		2011		2007-2011	
	%	PR	%	PR	%	95% CI	%	PR	%	95% CI	%	PR	%	PR	%	95% CI		
Northeast	7.4	1.38	9.4	1.53	10.1	1.40	1.20-1.58	1.08	0.92-1.27	7.4	1.09	4.6	1.18	5.4	1.35	0.91-1.30	1.18	0.94-1.48
Midwest	7.9	1.53	9.9	1.38	12.1	1.68	1.38-1.68	1.22	1.10-1.35	7.6	1.32	5.3	1.35	7.1	1.35	1.17-1.49	1.35	1.18-1.55
South	9.1	1.38	10.9	1.38	12.6	1.51	1.26-1.51	1.15	1.04-1.27	8.3	1.22	5.8	1.25	7.3	1.25	1.09-1.37	1.25	1.09-1.45
West	5.8	1.40	7.0	1.40	8.1	1.69	1.15-1.69	1.16	0.91-1.47	5.1	1.24	2.9	1.32	3.8	1.32	0.95-1.63	1.32	0.95-1.84

Note: ^aAnalytic sample included 79,264 children in 2003, 73,123 children in 2007, and 76,015 children in 2011. HS = high school; PR = prevalence ratio; SCHIP = State Children's Health Insurance Program. ^bFederal poverty level; multiple imputations were used for 10.0% of 2003, 8.9% of 2007, and 9.4% of 2011 for which household income was missing.

among those with ever diagnosed ADHD increased from 2007 to 2011, from 78.1% to 82.3% ($\chi^2_1=7.93, p < .01$). The distribution of ADHD severity shifted from 2007-2011 (mild: 46.7% vs. 41.4%, moderate: 39.5% vs. 43.1%, severe: 13.8% vs. 15.5%; $\chi^2_2=3.09, p < .05$). The pattern in the proportion of children reported to have current ADHD over time varied as a function of child race ($F_{2, 142348} = 6.40, p < .005$). Specifically, the proportion of children with current ADHD decreased among children who were multiracial or of other races, whereas it increased among children of white or black races (Table 2).

Current Medication Treatment for ADHD and Treatment by a Mental Health Professional. ADHD medication treatment increased 28% from 2007 to 2011 from 4.8% to 6.1% (Table 2), an average annual increase of 7%. The proportion of children taking medication within strata of parent-reported severity was statistically similar in 2007 and 2011. Descriptively, the demographic groups with the greatest relative increases in current medication prevalence were females, 4- to 10-year-olds, whites, children living above 100% of the Federal poverty level, and children living in the Midwest. The pattern of the proportion of children taking medication for ADHD varied as a function of child race ($F_{2,142334} = 5.55, p < .005$); the proportion of children taking medication for ADHD decreased among children of multiracial/other races whereas it increased among children of white or black races (Table 2).

Although the prevalence of current mental health treatment or counseling among those with current ADHD remained similar from 2007 to 2011, the percentage of children who either received that treatment or were taking ADHD medication increased (from 78.9% to 82.5%; $\chi^2_1 = 3.90, p < .05$), due to increases in ADHD medication treatment. Among those not receiving either of the 2 forms of treatment, 63.6% were reported as having mild ADHD (95% CI = 57.8-69.1), 29.5% as moderate (95% CI = 24.5-35.1), and 6.9% as severe (95% CI = 4.4-10.5).

ADHD Prevalence and Medicated Prevalence Stratified by Age and Sex. Prevalence of ADHD diagnosis and current medication treatment for ADHD are presented by sex-stratified age groups across the 3 survey periods in Figure 3. Increasing prevalence over time can be seen from the growing size of the inverted pyramid, with a relatively consistent sex ratio for each indicator. Among boys, the 2003 prevalence of ever-diagnosed ADHD (outer bars) was less than

15%, regardless of age; in 2007, the estimates exceeded 15% for individuals 9 to 17 years of age, with the exception of those 12 years of age (13.6%); in 2011 the estimates exceeded 15% for those 10 to 17 years, and exceeded 20% for those 11 years and 14 years. Among girls, the 2003 prevalence of ever-diagnosed ADHD (outer bars) increased from ages 4 to 8 years, then stabilized at 5% to 6% for those 9 to 17; in 2007, the prevalence increased with estimates ranging from 5.7% among 10-year-olds to 11.5% among 16-year-olds; in 2011 the prevalence ranged from slightly more than 5% to slightly more than 10% for all but 14-year-olds, for whom the estimated prevalence of ever-diagnosed ADHD was 11.6%.

The medication treatment question was asked of parents reporting ever-diagnosed ADHD in 2003 and parents reporting current ADHD in 2007 and 2011. In 2003, medicated ADHD prevalence increased from ages 4 to 9, stabilized, and then decreased in the teen years for both sexes. Estimates of medicated ADHD increased in 2011, as compared to 2007, particularly among teen boys. In 2011, the highest medicated ADHD prevalence was among 11-year-old boys (13.3%). Among girls, medicated ADHD remained at less than 5% until 2011, when the estimates met or exceeded 5% for girls 9 to 10 and 14 to 15 years of age.

DISCUSSION

The epidemiological profile for ADHD diagnosis and treatment continues to evolve. Based on parent-reported indicators of health care provider-diagnosed ADHD diagnosis and treatment, more than 1 in 10 school-aged children (11%) had received an ADHD diagnosis by a health care provider by 2011, representing more than 6.4 million children nationally. Nearly 1 in 5 high school boys and 1 in 11 high school girls had been diagnosed with ADHD. Of those with a history of ADHD, 83% had current ADHD in 2011 (8.8% nationwide), and 69% of these children and adolescents (6.1% nationwide) were taking medication for ADHD. These estimates are all significantly higher than comparable 2007 estimates.²⁸ Specifically, after a 22% increase in parent-reported history of ADHD diagnosis from 2003 to 2007, the prevalence increased another 16% from 2007 to 2011, a total increase of 42% from 2003 to 2011. Medicated ADHD among children living in the United States increased by 27% from 2007 to 2011. Among children with

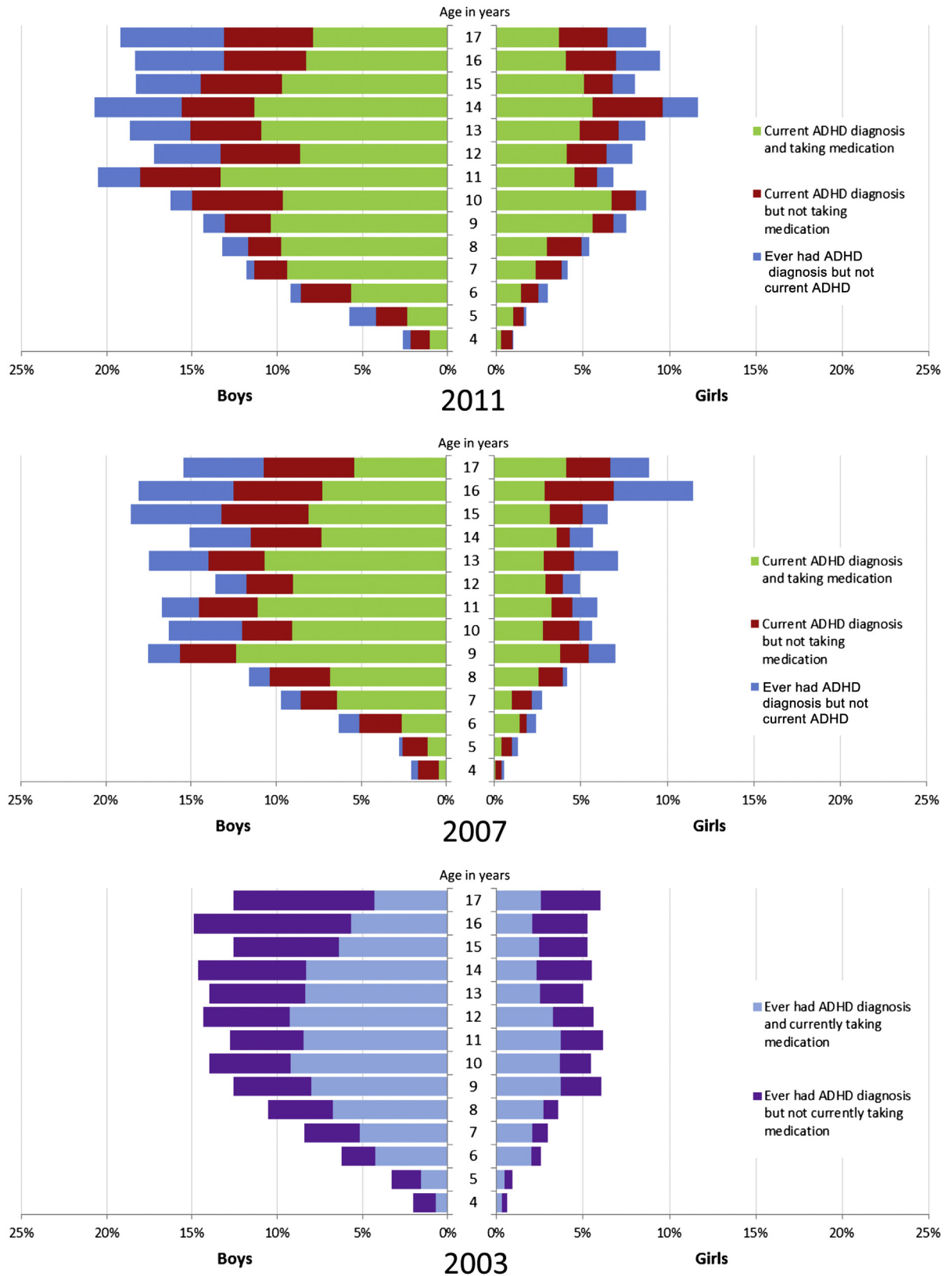
a history of ADHD, proportionately more had current ADHD in 2011, as compared to 2007. Taken together, an estimated 2 million more American children were diagnosed with ADHD, and 1 million more were taking ADHD medication in 2011 compared to 2003.

This study reveals a number of important and consistent demographic patterns for ADHD diagnosed by health care providers. Parent-report of ADHD diagnosis increased for most demographic subgroups; however, after increasing significantly from 2003 to 2007, the prevalence of a history of ADHD diagnosis was statistically similar between 2007 and 2011 among older teens and decreased among children who were multi-racial or of other races.

Direct comparisons of the 2003 to the other medication indicators were not appropriate. From 2007 to 2011, medicated ADHD prevalence increased overall but remained statistically similar among children who were multi-racial or of other races. Medicated ADHD estimates within each ADHD severity strata were statistically similar during this time period. The estimated treated prevalence of ADHD (mental health treatment plus medication) increased from 2007 to 2011, due to increases in medicated ADHD; however, as many as 17.5% of children with current ADHD were not receiving 1 of the forms of treatment for ADHD in 2011, more than one-third of whom had moderate or severe cases.

The findings in this report are subject to several limitations. First, as noted earlier, the ADHD indicators used here did not assess ADHD symptoms but, rather, relied on parent-report of diagnosis by a health care provider, which may introduce recall bias. The parent-reported indicators have not been clinically validated; however, a recent analysis indicated that parent-reported survey data produced similar estimates as those from insurance claims data, providing evidence of convergent validity for parent-reported ADHD diagnosis by a health care provider.³³ Second, the cell phone sample inclusion could have affected the 2011 estimates; analyses of restricted-use data suggest that children living in cell phone-only households in 2011 were more likely to have current ADHD than children living in landline phone households (10.0% vs. 8.4%); therefore, non-coverage of cell phone-only households in 2007 may have underestimated prevalence. Third, survey responses were limited to those who agreed to participate, and response rates in 2011 were

FIGURE 3 Weighted prevalence estimates (%) of parent-reported attention-deficit/hyperactivity disorder (ADHD) diagnosis by a health care provider among children, by age and medication status (United States, 2003, 2007, and 2011).



lower than those in 2003 and 2007; however, nonresponse bias is attenuated by the inclusion of demographic factors in the sample weight calculations, although nonresponse bias cannot be ruled out. Fourth, although medication treatment and mental health treatment indicators were included in this study, other forms of treatment for ADHD were not collected, and estimates of ADHD treatment may therefore underestimate treated prevalence. Finally, the cross-sectional data in this report cannot be used to determine the cause of increased prevalence or the appropriateness of diagnosis or medication treatment. However, these data do allow for ecological analyses of changes in policies and demographic characteristics, as conducted by Fulton *et al.*³⁴

The increasing prevalence estimates of parent-reported ADHD diagnosis are generally consistent with previous rates of increase. These increases could indicate that the actual prevalence of underlying ADHD has increased consistently over time; however, the proxy data used in this report prohibits drawing firm conclusions about changes in the underlying prevalence of ADHD. The increases could also reflect better detection of underlying ADHD, due to increased health education and awareness efforts. A number of contextual factors are known to influence the frequency with which childhood ADHD is diagnosed, including increased awareness efforts, educational policies, physician characteristics, cultural factors, and changes in public perception.³⁴⁻³⁷ Other factors, such as increased confidence to treat ADHD among clinicians and increased exposure to etiologic factors (e.g., environmental contaminants) may also play a role. The magnitude of increases documented with these cross-sectional data warrant future efforts to more fully understand the factors affecting ADHD diagnosis.

The increases in parent-reported medication for ADHD are consistent with previous research^{29,38} and should be considered within a broad context. Medication treatment is the single most effective ADHD treatment, resulting in immediate and meaningful improvements in ADHD symptoms that surpass the efficacy of behavioral therapy alone.^{11,12} The effectiveness of ADHD medication on ADHD symptoms has likely contributed to the ADHD medication initiation and continuance. However, we do not fully understand the long-term impact of taking ADHD medication over time. Long-term functional outcomes are consistently and heavily influenced by symptom

trajectory, sociodemographic factors, and treatment history.³⁹ However, there is also some evidence that long-term use of ADHD medication normalizes right dorsolateral prefrontal cortex activation.⁴⁰ There has been concern and conflicting evidence about the risk of ADHD medication use and later substance use disorders among adolescents and young adults⁴¹⁻⁴³; however, a recent meta-analysis of this research suggests that ADHD medication neither protects against nor increases the risk of substance use disorders.⁴⁴ Given the increasing medication treatment patterns and the developing literature about the risks of both intervening and failing to intervene, continued research on the long-term benefits of ADHD treatment, both pharmacological and behavioral, is needed.

Nationally, the increases in parent-reported ADHD diagnosis and associated medication treatment occurred during a period in which the Food and Drug Administration (FDA) issued 3 Public Health Alerts and a series of communications regarding cardiac and psychiatric risks of ADHD medications.^{45,46} Others have documented upward trends in ADHD medication treatment despite these safety alerts, which contrast with the downward trends seen in pediatric antidepressant use after alerts regarding suicidality.^{45,47,48} Prevalence of ADHD medication use also increased despite an overall downward trend in pediatric medication prescriptions.⁴⁹ Notably, there has been an increase in antipsychotic medication use among children, including concomitant use of multiple psychotropic medications, with the most common combination being ADHD medication and an antidepressant.^{50,51} Finally, the 2011 medication treatment estimates may have been somewhat constrained by the ADHD medication shortages experienced throughout the United States from 2009 to 2011.^{52,53}

The findings of this report have several important clinical and public health implications. Parent-reported prevalence estimates provide insight into the demand that this population has on the systems supporting them, and these data suggest that the impact of ADHD may be increasing. ADHD is commonly diagnosed before age 5 years in children with severe ADHD; children diagnosed with ADHD in early childhood may benefit from targeted interventions. Attention to the transitional needs of the large population of high school students taking medication for ADHD (6.4%) may be

warranted, particularly given increasing concerns about abuse, misuse, and diversion of medication to others.⁵⁴⁻⁵⁶ Based on this report's estimates, the cross-sector costs associated with ADHD likely exceed the previously estimated upper bound of \$78 billion.⁵⁷ Future cross-public health system

efforts should continue to describe and monitor ADHD diagnostic and treatment patterns, assess the alignment of these patterns to best practices, and seek to understand the factors influencing the evolving prevalence of ADHD diagnosis and treatment. &

CG Clinical Guidance

- The parent-reported prevalence of a history of an attention-deficit/hyperactivity disorder (ADHD) diagnosis by a health care provider among U.S. school-aged children increased from 7.8% in 2003 to 11% in 2011, an increase of 42% in less than a decade.
- In 2011, the median age of ADHD diagnosis was approximately 6 years of age, but children reported by their parents as having more severe ADHD were diagnosed earlier.
- The percentage of US school-aged children with a parent-report of current medication treatment for ADHD increased from 4.8% in 2007 to 6.1% in 2011, an increase of 27% in approximately 4 years.
- More U.S. school-aged children were receiving ADHD treatment in 2011 than in 2007, but nearly 1 in 5 with current ADHD were not receiving either medication for ADHD or mental health counseling in 2011.

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Ms. Visser, Ms. Danielson, and Drs. Bitsko, Holbrook, and Perou are with the Division of Human Development and Disability, National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention (CDC). Drs. Kogan and Ghandour are with the Office of Epidemiology and Research, Maternal and Child Health Bureau, Health Resources and Services Administration. Dr. Blumberg is with the Division of Health Interview Statistics, National Center for Health Statistics, CDC.

Ms. Danielson served as the statistical expert for this research.

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Correspondence to Susanna Visser, MS, National Center on Birth Defects and Developmental Disabilities, Centers for Disease Control and Prevention, E-88, 1600 Clifton Road, Atlanta, GA 30333; e-mail: svisser@cdc.gov

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TABLE S1 National Survey of Children's Health 2011–2012: Attention-Deficit/Hyperactivity Disorder (ADHD)–Related Survey Questions

K2Q31A	<p>Has a doctor or other health care provider ever told you that [S.C.] had... Attention Deficit Disorder or Attention Deficit Hyperactivity Disorder, that is, ADD or ADHD?</p> <p>HELP SCREEN (K2Q31A): A child with Attention Deficit Disorder or Attention Deficit Hyperactivity Disorder has problems paying attention or sitting still. It may cause the child to be easily distracted.</p> <p>(1) YES (2) NO (77) DON'T KNOW (99) REFUSED</p>
K2Q31B	<p>Does [S.C.] <i>currently</i> have ADD or ADHD?</p> <p>(1) YES (2) NO (77) DON'T KNOW (99) REFUSED</p>
K2Q31C	<p>Would you describe [his/her] ADD or ADHD as mild, moderate, or severe?</p> <p>(1) MILD (2) MODERATE (3) SEVERE (77) DON'T KNOW (99) REFUSED</p>
K2Q31D	<p>Is [S.C.] currently taking medication for ADD or ADHD?</p> <p>(1) YES (2) NO (77) DON'T KNOW (99) REFUSE</p>
K2Q31A_1	<p>Earlier you told me that [S.C.] currently has ADD or ADHD. How old was [S.C.] when you were first told by a doctor or other health care provider that [he/she] had ADD or ADHD?</p> <p>RECORD AGE IN YEARS OR MONTHS</p> <p>(77) DON'T KNOW (99) REFUSED</p>

FIGURE S1 Percentage distribution of age at attention-deficit/hyperactivity disorder (ADHD) diagnosis by a health care provider based on retrospective parent report, by parent-reported current ADHD severity (United States, 2011–2012).

