The Extent of Drug Therapy for Attention Deficit–Hyperactivity Disorder Among Children in Public Schools

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ABSTRACT

Objectives. The purpose of this study was to determine the extent of medication use for attention deficit–hyperactivity disorder (ADHD) in southeastern Virginia.

Methods. Students enrolled in grades 2 through 5 in school districts in city A (n = 5767 students) and city B (n = 23 967 students) were included. Nurses recorded students who received ADHD medication in school.

Results. The proportion of students receiving ADHD medication was similar in both cities (8% and 10%) and was 2 to 3 times as high as the expected rate of ADHD. Receipt of drug therapy was associated with social and educational characteristics. Medication was used by 3 times as many boys as girls and by twice as many Whites as Blacks. Medication use increased with years in school, and by fifth grade 18% to 20% of White boys were receiving ADHD medication. Being young for one's grade was positively associated with medication use ($P < .01$). The prevalence of ADHD was 12% in district A, 63% in district B.

Conclusions. These findings suggest that criteria for diagnosis of ADHD vary substantially across US populations, with potential overdiagnosis and overtreatment of ADHD in some groups of children. (*Am J Public Health.* 1999; 89:1359–1364)

Attention deficit–hyperactivity disorder (ADHD) is one of the most commonly diagnosed conditions of childhood.[1,2] Because the majority of children with ADHD in the United States are treated with stimulant medication,[3] and of these approximately 90% receive methylphenidate (Ritalin),[4,5] the use of methylphenidate is an indicator of the prevalence of ADHD in the United States. Since 1990, the number of prescriptions for methylphenidate, the per capita distribution of methylphenidate, and the number of ADHD patient visits for ADHD have increased 3- to 6-fold.[6,7] There is some evidence that these increases are associated with changes in ADHD diagnostic criteria that make the condition easier to recognize[8] and with changes in medical guidelines that support the use of stimulant medication into adolescence and adulthood.[9] However, possible overdiagnosis and overtreatment of ADHD in the United States was recently recognized by the National Institutes of Health as an important public health problem.[10]

No national study of the proportion of children diagnosed with or treated for ADHD has been conducted. Studies involving children and youth in various regions of the United States and other countries have yielded ADHD prevalence estimates ranging from 1% to 26%.[8,9,11–18] Prevalence estimates vary as a function of study design, sample size, and year. The most conservative estimates (1% to 5%) have occurred in population-based studies of students with documented ADHD diagnoses[9,16]; the highest estimates (16% to 26%) have occurred in studies involving smaller sample sizes and participants who meet ADHD screening criteria rather than students known to have been diagnosed with ADHD.[8,11]

Despite the lack of national prevalence data, the prevailing expert opinion is that between 3% and 5% of US children have the disorder[9,10,19,20] and that fewer than 3% of school-aged children receive medication for ADHD.[21] Prevalence studies have consistently reported ADHD to be at least 2 times more prevalent among boys than among girls.[3] Similarly, ADHD studies have consistently found a positive association between ADHD and academic problems[22]; however, the degree of comorbidity varied greatly (from 10% to 90%) across studies. ADHD has been described as more prevalent among children from minority and low-income populations,[20] but research findings challenge this assumption.[23]

A series of studies involving Baltimore County school district data and Maryland Medicaid prescription data showed that the use of methylphenidate among school-aged children doubled every 4 years between 1971 and the mid-1980s and more than doubled between 1990 and 1995.[9,24–26] Despite the continued increase in methylphenidate use observed in these studies, Safer and his colleagues reported that through 1995 the prevalence of ADHD among school-aged children in the United States remained below 5%.[9] However, per capita distribution rates for methylphenidate vary as much as 6-fold across states.[27] The study of Safer et al. emphasized data from low-distribution states; therefore, their findings may not reflect ADHD treatment trends across the nation.

Additional studies involving data from states with low and high rates of methylphenidate distribution are needed to address the ongoing controversy about possible ADHD

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overdiagnosis and overtreatment. In 1995, Virginia had the highest per capita methylphenidate distribution rate in the United States[28]; however, individual-level data were not available for epidemiologic study. The present study was designed to assess the proportion of students receiving medication for ADHD during the 1995–1996 school year in 2 school districts in southeastern Virginia. We also examined the association between ADHD medication use and students' ethnicity, sex, educational characteristics, and other social characteristics.

Methods

Study Population

The study population included all public school students enrolled in grades 2 through 5 in city A (n = 5767) and city B (n = 23967) as of October 1, 1995. Many children are diagnosed with ADHD only after formal schooling has been initiated, and such children would not have been through the diagnostic testing and medication trials before the end of first grade. Older children were excluded because by middle school many children with ADHD do not take medication from a school nurse.

For every 10000 children younger than 18 years in cities A and B, there were 17.4 physicians registered with the Medical Society of Virginia who would be likely to treat children diagnosed with ADHD (pediatricians, family practice physicians, child psychiatrists, and neurologists). Because the 2 cities are in close proximity to each other and to the only children's hospital in the region, separate medical provider information is not reported.

To avoid inflating the ADHD treatment rate, we omitted from the analysis students in nongraded special education placements, which were designed for children with severe intellectual impairments. Such children often experience attentional difficulties secondary to their intellectual disabilities. Some of these children carry a diagnosis of ADHD, but it is often presumed that the attentional difficulties are related to their global neurologic impairments (e.g., profound mental retardation and autism) rather than to ADHD per se.

Data Collection

Data collection methods were similar for the 2 school districts. Each database used in this study refers to a single point in time during the 1995–1996 school year. Students' names were deleted before data sets were released to the principal investigator (G.B.L.). In city A, scan sheets were used to capture health-related information for all students who were routinely administered medication during school hours. This information included primary, secondary, and tertiary medical diagnoses as indicated on a physician-signed form listing conditions for which medication was prescribed. The health-related information was merged with the school district's comprehensive student database to create a health database that included each student's identification number, race, sex, grade, special education status, date of birth, and neighborhood (indicated by the 1990 US Census tract code corresponding to the student's address).

To verify the accuracy of the school health database, a nurse research assistant visited each school in the district to review the records of children taking ADHD medication. Name, identification number, and medication administered was recorded for every child with a physician-signed form indicating an ADHD diagnosis. Computerized school health and headcount databases were compared by student identification number. School health data were collected during the fall of 1995 and scanned into the computer during January 1996. Nurse record data were collected during March 1996. Fewer than 100 discrepancies were found, and they reflected changes that occurred between December and March.

In city B, for every student to whom ADHD medication was administered, the school nurse recorded the student's name, identification number, and medication administered as indicated by physician-signed medication administration forms. These data were collected during April 1996. A database containing this information was created and merged by name and identification number with the school district's comprehensive enrolled-student database. A subset of this database, including each student's age, race, sex, ADHD diagnosis (present or absent), and medication administered, was provided to the principal investigator. Subsequently, military family status and neighborhood codes corresponding to student addresses were provided for all children eligible for enrollment in city B public schools (the eligible-student data set, n = 25924) during the 1995–1996 school year; military status and neighborhood codes were not provided for students actually enrolled as of October 1, 1995 (the enrolled-student data set, n = 23967).

As a result of information system and personnel constraints in the school district and the lack of unique identifiers in the data sets released to the principal investigator, the eligible-student data set could not be corrected to exclude nonenrolled students, for whom ADHD information was not collected. Thus, the enrolled-student data set, rather than the eligible-student data set, was used for city B except for analysis of ADHD prevalence rates of civilian vs military families or analyses involving information associated with students' residential neighborhood. To ensure that analysis of the eligible-student data set would yield meaningful results, we compared ADHD prevalence rates from the eligible-student and enrolled-student data sets. Rates were reduced by only 0.2% to 1.1% in race and sex categories when students who were eligible but not enrolled were included.

Demographic information obtained from the 1990 US Census was linked to school databases to characterize each student's residential neighborhood with regard to median household income, percentage of single-parent households, and percentage of adults with the following characteristics: receipt of public assistance, at least an 8th grade education, at least a 12th grade education, and history of military service (men only).

Definitions

Medication use for ADHD. Medication use was assessed as the percentage of students, at the time of data collection, taking medication from a school nurse during school hours for ADHD as indicated by a physician's diagnosis on a medication administration permission form. According to the terminology of the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition,*[19] the term ADHD includes related diagnostic codes such as attention deficit disorder and hyperkinetic syndrome of childhood. Because of inconsistency in the terminology used by clinicians, the specific form of ADHD (primarily hyperactive type, primarily inattentive type, or combined type) was not specified.

Age-for-grade classification. Because grade retention data and other academic performance indicators were not available for analysis, an age-for-grade classification was created. Students who were a year or more below the expected age for their grade were defined as young for grade and students who were a year or more older than the expected age for their grade were defined as old for grade. Expected age for grade was based on the assumption that students began kindergarten at age 5 years, first grade at 6 years, and so forth, plus or minus 1 year. Eight students in city A and 22 students in city B were excluded from age-for-grade analyses because their dates of birth were missing or their dates of birth were inaccurate so that

they were 2 or more years younger than the expected age for their grade.

Military and civilian children. For financial purposes, school districts routinely record whether a student has a parent on active military duty; however, this information was provided by the city B district only. Students with a parent on active duty were described as military children; all other students were described as civilian children.

Statistical Analysis

Descriptive statistics and logistic regression analyses were performed with SPSS 7.5 for Windows.[29] ADHD medication use during school hours was the outcome variable in logistic regression analyses. Age, race (Black/White), sex, age-for-grade classification (young, expected age, old), military family status (city B only), census data for the student's neighborhood, and all 2-way interactions were included in initial statistical modeling. Median household income was the only significant neighborhood variable in the final logistic regression models. Interaction effects could be eliminated as nonsignificant except for the interaction of median household income and race in city A. Therefore, ADHD medication use was analyzed separately for Black and White students in city A. Adjusted odds ratios from the final logistic regression models were compared with crude odds ratios. In each case, minimal change occurred, with no alteration in significance. Therefore, odds ratios reported are crude (unadjusted). Significance was set at $P<.05$.

Results

Sample Characteristics

Demographic characteristics of the 2 cities and their school districts are summarized in Table 1. City A and city B are similar with respect to dollars expended per student. The cities differ in size, racial composition, median household income, and percentage of individuals living in poverty.

ADHD Medication Use

The majority (90%) of children receiving medication in school for ADHD were given methylphenidate. Five percent received methylphenidate in combination with other drugs, and 10% received another ADHD medication alone. The percentage of students receiving ADHD medication generally increased with grade; the increase from second to fifth grade was from 7% to 9% in city A and from 7% to 10% in city B. The percentage was highest in fifth grade, in which 18% of White boys in city A and 20% of White boys in city B were given ADHD medication in school.

TABLE 1—Characteristics of 2 Virginia Cities in Which Prevalence of Drug Therapy for Attention Deficit–Hyperactivity Disorder (ADHD) Was Studied, 1995–1996[a]

	City A	City B
Demographic characteristics		
Median household income, $	24 601	36 271
Individuals living in poverty, %		
All	17	6
Black	29	13
White	7	4
Children <18 y	27	8
Adult males in military service, %	3	11
Students enrolled in public school, %	91	88
School district characteristics		
Students in public school, No.	183 000	75 819
Average expenditure per student, $	4 856	4 278
Military families, %	NA	32
Students in grades 2–5, No.	5 767	23 967
Percentage of students in grades 2–5 receiving ADHD medication in school		
	No. in group (% receiving medication)	
By race and sex		
Black boys	1 905 (9.1)	2 839 (8.9)
White boys	1 006 (16.8)	8 585 (16.6)
Black girls	1 941 (3.3)	2 740 (2.8)
White girls	841 (6.7)	8 153 (6.8)
All	5 693 (8.2)	22 217 (9.9)
By age-for-grade category		
Young for grade	295 (3.7)	770 (62.7)
Expected age for grade	5 230 (8.2)	22 297 (8.0)
Old for grade	234 (12.4)	878 (10.1)

[a]City-specific data were drawn from the 1990 US Census. All other data were obtained from school district databases.

The overall proportion of students in grades 2 through 5 receiving ADHD medication in school was 8% in city A and 10% in city B. The proportions were consistent between the 2 districts with respect to race and sex: 17% of White boys, 9% of Black boys, 7% of White girls, and 3% of Black girls received medication at school for ADHD (Table 1). In city B, 32% of the children were from military families. Military children were significantly more likely than civilian children to take ADHD medication during school hours (10% vs 9%, $P<.02$).

ADHD Medication Use by Age-for-Grade Category

The majority of students in both cities (91% in city A and 93% in city B) were enrolled in the expected grade for their age. Young-for-grade students constituted 5% of the student population in city A and 3% in city B; old-for-grade students constituted 4% of the student population in city A and 4% in city B.

ADHD medication use varied significantly across age-for-grade categories in city A ($P=.001$) and city B ($P<.001$) (χ^2 analysis). In city A, 12 of 295 (3.7%) young-for-grade students used medication for ADHD, contrasted with 29 of 234 (12.4%) old-for-grade students. In city B, a very different pattern emerged: 483 of 770 (62.7%) young-for-grade students used medication for ADHD, contrasted with 89 of 878 (10.1%) old-for-grade students. As Figure 1 illustrates, there is evidence of increased risk for medication use among young-for-grade students across all sex-and-race groups in city B; therefore, the finding is not attributable to confounding.

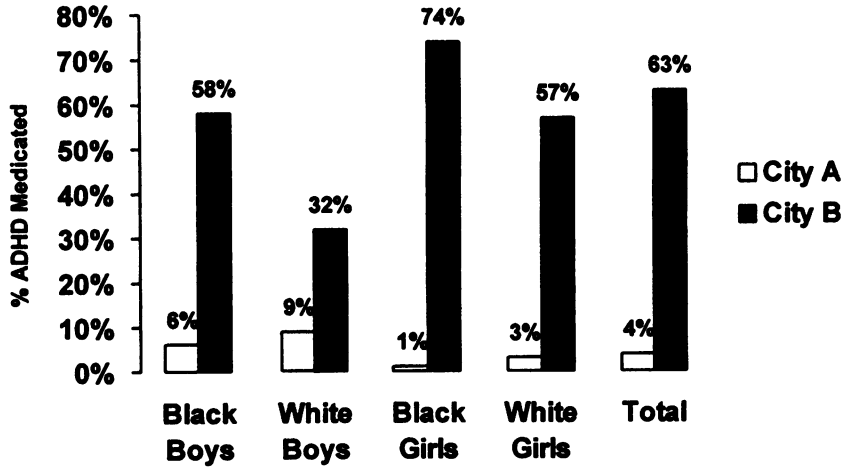
Odds Ratios for Factors Associated with ADHD Medication Use

Initial logistic regression models included all factors that were significant in univariate analyses, including sex, race, young-for-grade status, old-for-grade status, and median household income. Characteristics that were significantly associated with ADHD medication use and their corresponding odds ratios are shown in Table 2. Sex and race were similarly associated with medication use in both cities. Boys were approximately 3 times as likely as girls and White students were approximately twice as likely as Black students to receive ADHD medication.

In city A, old-for-grade students were 1.6 times as likely ($P<.001$) as other students to receive ADHD medication in school. In city B, age for grade was the strongest predictor of ADHD medication use. Compared with other students, students who were young for their grade were 21 times as likely to take ADHD medication ($P<.001$).

In city A, use of ADHD medication was associated with median household income; however, there was a significant interaction between median household income and race (odds ratio [OR] fixed interaction term = 1.3, 95% confidence interval = 1.03, 1.54, $P<.05$). Therefore, data were analyzed separately for Black and White children. Among Black children, lower socioeconomic status (SES), as indicated by median household income, was not associated with use of ADHD medication (OR = 1.2, 95% CI = 0.95, 1.53). Among White children lower SES was a significant predictor of medication use. For every $20 000 decrease in median household income, the odds of taking ADHD medication more than doubled (OR = 2.1, 95% CI = 1.56, 2.94, $P \leq .001$).

Median household income data for city B students and public assistance data for students in both cities were significant in some analyses; however, the results varied considerably, depending on the cutpoints used to define categorical variables. Therefore, significant associations between public assistance and ADHD medication use were judged to be unreliable and are not reported.



Note. The overall percentages are 4% (95% confidence interval [CI] = 1.8%, 6.2%) for city A and 63% (95% CI = 5.9%, 66.4%) for city B.

FIGURE 1—Percentages of young-for-grade public school students given medication for attention deficit–hyperactivity disorder (ADHD): Virginia, 1995–1996.

Discussion

Our study indicates that 8% to 10% of students in grades 2 through 5 in 2 cities in Virginia received medication for ADHD during the 1995–1996 school year. These figures constitute a conservative estimate of the prevalence of ADHD among young children in the cities studied, as we accounted only for children who took medication at school. Because some children diagnosed with ADHD do not take medication at school, it is difficult to know the extent to which our data reflect the total number of children diagnosed with ADHD. One study indicated that 79% of students with the disorder received at least one dose of their medication in school.[25] An ADHD expert, Russell Barkley, estimated that 3% of US schoolchildren take medication for ADHD, while as many as 7% of US children may have the disorder.[30] If this estimated ratio of children treated in school to actual cases is accurate, the true proportion of children with ADHD in eastern Virginia may be 2 to 3 times as high as the 8% to 10% we estimated.

The percentages of students receiving ADHD drug therapy were similar in the 2 cities studied, with one important exception. In city A, old-for-grade students were more likely than other students to take ADHD medication at school. Old-for-grade students are likely to have a history of delayed school entry owing to slower development or grade retention because of poor performance. In contrast, in city B, young-for-grade students were more likely than other students to take ADHD medication at school, with nearly two thirds of the young-for-grade students having been administered ADHD medication at school. This dramatic prevalence figure suggests the possibility that parents and professionals in city B may have misconceptions about the behavior of young children, which may have contributed to an extremely high percentage of young-for-grade children receiving psychotropic medication. Follow-up studies are needed to address issues such as professionals' appreciation of developmentally appropriate inattention, impulsivity, and hyperactivity; the district's school readiness policies; and use of medication to enhance performance of precocious or academically advanced students.

Consistent with previous reports, we found that boys were more likely than girls to receive medication for ADHD. We also found that the prevalence of ADHD drug therapy increased with years in elementary school and peaked in fifth grade, by which time 18% to 20% of White boys took ADHD medication at school. As was reported in a study of psychopathology among military and civilian children,[31] we found that military children were more likely than civilian children to be diagnosed with ADHD. However, the magnitude of the difference was small, and it did not account for the overall high prevalence of ADHD drug therapy.

Like other developmental, learning, and mental health disorders, ADHD has been reported to be more prevalent among children from minority and low-SES environments.[20] Even after controlling for factors such as median household income and sex, we found that ADHD medication was administered twice as often to Whites as to minority students. Similar racial differences were described in a recent analysis of 1991 Maryland Medicaid data.[23] It is possible that ADHD is more prevalent in low-SES and minority populations than in higher-SES and nonminority populations, and that the observed differences reflect parents' decisions to fill prescriptions and/or to make prescribed medication available to their children in school.

Ninety percent of the children who took ADHD medication at school were given methylphenidate. Five percent received a combination of methylphenidate and other drugs, and 10% were given other drugs alone. There is a growing trend to treat ADHD children with multiple medications, particularly stimulants and antidepressants.[32,33] Nationally, the number of prescriptions for fluoxetine HCl (Prozac) and other serotonin reuptake inhibitors (i.e., antidepressants) for children aged 6 to 18 years increased by 80% from 1994 to 1996.[34] Therefore, future studies of drug therapy for

TABLE 2—Odds Ratios (ORs) for Use of Medication for Attention Deficit–Hyperactivity Disorder Among Public School Students in Grades 2 through 5, by Selected Characteristics: Virginia, 1995–1996

	City A (n = 5767) OR (95% CI)	City B (n = 23 967) OR (95% CI)
Male	3.0 (2.42, 3.70)*	2.8 (2.52, 3.05)*
White	2.1 (1.74, 2.54)*	2.2 (2.03, 2.41)*
Young for grade	0.4 (1.28, 4.33)*	20.8 (17.86, 24.27)*
Old for grade	1.6 (1.09, 2.43)*	1.0 (0.82, 1.29)

*Significant at $P<.001$.

ADHD should take into account Prozac and other medications that are increasingly used to treat children diagnosed with ADHD.

There are some limitations to the present study. First, clinicians may have used a diagnosis of ADHD to describe children with behavioral symptoms associated with other disorders, such as depression, anxiety, learning disabilities, or child abuse. Describing such children as having ADHD may do them a disservice by depriving them of in-depth evaluations and etiologically based interventions that include requisite nonpharmacologic interventions. Inappropriate application of the diagnosis also undermines the legitimacy of the disorder for children with substantiated neurologic problems.[35] The tendency to assume a biological cause for difficult child behavior, without adequately examining potential environmental contributions, has been observed in the related field of child temperament.[36,37] Second, there was some evidence suggesting significant associations between neighborhood factors (e.g., median household income and percentage of adults on public assistance) and ADHD medication use. However, these neighborhood (i.e., ecologic) data should be interpreted cautiously. Characterization of SES by census tract of residence does not necessarily reflect the SES of a child's family.

Despite these limitations, several important conclusions can be drawn from this population-based study. The high prevalence rates suggest that ADHD was overdiagnosed and overtreated in some groups of children. On the basis of studies published through 1997, the American Medical Association's Council on Scientific Affairs concluded that "there is little evidence of widespread overdiagnosis or misdiagnosis of ADHD or widespread overprescription of methylphenidate."[38(p1100)] We describe new findings that suggest regional variability in the extent of ADHD labeling and treatment. Additional prevalence studies are needed before public and professional concern about ADHD overdiagnosis and overtreatment can be dismissed. An assessment of ADHD diagnosis and methylphenidate use in regions characterized by widely differing methylphenidate distribution rates, or a national study of ADHD diagnoses and methylphenidate use, would provide information necessary to adequately address the ongoing debate about ADHD overtreatment and overdiagnosis.

In an article published in the *New England Journal of Medicine* in 1975,[39] Sroufe and Stewart noted that the use of methylphenidate to treat childhood behavior problems had been increasing steadily. They advocated a critical appraisal of stimulant medications before the use of such drugs increased any further. Since that article was published, hundreds of studies have documented the short-term benefits of stimulant medications, but there remains a dearth of evidence demonstrating long-term benefits of stimulant treatment on school achievement, peer relationships, or behavior problems in adolescents.[40] Because of the paucity of data on the long-term consequences of stimulant medication and the unexplained racial and socioeconomic differences in ADHD treatment, the steady rise in the use of ADHD medication is an important public health issue. Further research is needed to clarify the long-term social, psychological, and biological consequences of ADHD drug therapy; to determine the prevalence of multimodal ADHD treatment; and to provide a framework for design and implementation of educational programs that ensure appropriate use of stimulant medications and nonpharmacologic interventions. □

Contributors

G. B. LeFever planned the study, analyzed the data, and wrote the manuscript. K. V. Dawson assisted in the logistics of accessing school division data and in data entry, data interpretation, and manuscript editing. A. L. Morrow provided guidance on all phases of the project.

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