ARTICLE

Health Care Use and Costs for Children With Attention-Deficit/Hyperactivity Disorder

National Estimates From the Medical Expenditure Panel Survey

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Context: Although attention-deficit/hyperactivity disorder (ADHD) is a highly prevalent chronic condition of childhood, little is known about patterns of health care use and associated expenditures.

Objective: To compare health care use and costs among children with ADHD, children with asthma, and the general pediatric population.

Design and Setting: The 1996 Medical Expenditure Panel Survey, a nationally representative household survey.

Participants: All 5439 children aged 5 to 20 years from the 1996 Medical Expenditure Panel Survey were included in this analysis. Children who had ADHD, asthma, or neither (general population) were identified from *International Classification of Diseases, Ninth Revision, Clinical Modification* codes and prescription records.

Main Outcome Measures: Mean health care use (outpatient visits, emergency department visits, hospital stays, home health visit days, and prescriptions) and associated expenditures.

Results: We identified 165 children with ADHD, 322 with asthma, and 4952 with neither diagnosis. Children with ADHD had significantly higher mean total health care costs ($1151) compared with children with asthma ($1091; $P<.05$) and the general population ($712; $P<.001$). After adjusting for age, sex, race, household income, access to care, parent education, and marital status, excess total costs were $479 for children with ADHD ($P<.001$) and $437 for children with asthma ($P<.01$).

Conclusions: Overall costs of care for children with ADHD are comparable to costs for children with asthma and significantly greater than for the general pediatric population. Specific types of health care use and the sources of expenditures differ between children with ADHD and children with asthma. Because much ADHD-related care occurs within school and mental health settings, these figures likely underestimate the true costs of caring for children with this condition.

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ATTENTION-DEFICIT/hyperactivity disorder (ADHD) is the most commonly diagnosed behavioral disorder in children, with estimates of prevalence ranging from 3% to 11%.[1-3] Children with ADHD are not only more likely to experience difficulties in daily functions, such as school performance, social competence, family relationships, and delinquency, but are also at increased risk for other physical and mental health disorders, such as injury, depression, and substance abuse.[4-7] Evidence of rising prevalence[8] and stimulant medication prescriptions[9] suggests that the impact of ADHD on the health care system is likely to be great.

However, little is known about patterns of health care use and associated costs in children with ADHD. The chronic nature of ADHD suggests that these children would have health care use and costs similar to children with asthma, another highly prevalent chronic condition of childhood, and greater than those of children without chronic illnesses. Children with ADHD presumably require more frequent outpatient visits for follow-up and medication management than children without a chronic condition; their prescription costs would also be elevated. A priori, such children would be more likely to use mental health services, such as diagnostic and consultation services, behavioral therapies, and counseling. Finally, the increased risk for accidental injury may lead to increased emergency department (ED) use; children with ADHD may also be more likely than children without ADHD to sustain serious injuries requiring hospitalization.[4]

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SUBJECTS AND METHODS

DATA SOURCE

The data source for this study was the 1996 MEPS Household Component. The MEPS is a nationally representative survey of health care use, expenditures, sources of payment, and insurance coverage for the US civilian, noninstitutionalized population. The Health Component is the core survey and collects detailed data at both the person and household levels, using an overlapping panel design with 5 rounds of computer-assisted personal interviews over a 2½-year period.[13] In the MEPS, one respondent per household is interviewed about the medical events of household members, including health status, health care utilization, and health insurance. Surveys of the household's medical providers, employers, and health insurers verify and supplement interview data.[14] In particular, medical providers, such as office-based physicians, hospitals, home health agencies, and pharmacies, serve as the primary source for expenditure information, including out-of-pocket payments by the family.

SUBJECTS

The sample for the 1996 MEPS Household Component was selected from households responding to the 1995 National Health Interview Survey, conducted by the National Center for Health Statistics, Hyattsville, Md. The MEPS sample encompassed 195 primary sampling units and 10 597 households; Hispanic and black households were oversampled at ratios of approximately 2:1 and 1.5:1, respectively.[14] The overall response rate for the 1996 MEPS was 70.2%.

The subsample of individuals used for this analysis consisted of all children aged 5 to 20 years. We identified eligible children primarily through diagnosis codes 314 (ADHD) and 493 (asthma), according to the *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)*.[15] We also used the presence of at least 2 prescriptions for psychostimulant medications, such as methylphenidate hydrochloride, dextroamphetamine sulfate, mixed amphetamine salts, and pemoline. These medications are rarely used for other conditions, except narcolepsy. We did not use prescription records to identify additional children with asthma, as some have suggested that this approach lacks specificity (ie, many falsely identified patients when relying on medication data alone).[16,17]

Children who had both ADHD and asthma were excluded from the analysis. Children who had neither ADHD nor asthma were included in our general population group. We used *ICD-9-CM* codes 300 (anxiety), 307 (tics, stereotyped movements, and sleep disorders), 311 (depression), 312 (conduct disturbance), 313 (emotional disturbances of childhood and adolescence), and 315 (learning difficulties) to identify children with ADHD with psychiatric comorbidities. Finally, we used the list of chronic and severe childhood conditions from the Massachusetts General Hospital Center for Child and Adolescent Health Policy, Boston (J. M. Perrin, MD, written communication, January 2002), to identify such children in the general population group.

MEASURES

The primary outcome measures were health care service use and associated costs. Services included outpatient visits, ED visits, hospital discharges, prescriptions, and home health visit days. Costs consisted of total as well as component costs, such as outpatient, ED, and home health visits, prescriptions, and hospital discharges. We also examined out-of-pocket costs, which included copayments and payments for services not covered by insurance. The MEPS, however, does not consider out-of-pocket costs as a component of total costs.

We studied the effects of 2 groups of variables likely to affect health care utilization and costs. The first group included child and family characteristics, such as age, sex, race, parent's education, parent's marital status, and perceived maternal health status. The second group of variables reflected access to health care, such as poverty status based on the federal poverty level, health insurance coverage, having a usual source of care, region of the United States, and living in an urban metropolitan area.

ANALYSIS

We first used analysis of variance, with pairwise comparisons, to test the differences in mean health services use and expenditures among the 3 groups. We then conducted linear regression analyses to evaluate the relationship between costs and group status, controlling for the effects of sociodemographic and access to care variables found to be significantly related to costs on initial bivariate analyses. The regressions also produced estimates of excess total costs for children with ADHD and asthma compared with the general pediatric population. Our final model included nonsignificant positive and negative confounders affecting the significant variables in our original model.

Although expenditure data are typically somewhat skewed, the weighting involved in national survey data allows for the application of the central limit theorem and the use of means-based tests instead of either nonparametric tests[18] or log transformation of the data. We were thus able to preserve the interpretability of the results as dollars. We examined expenditure distributions to identify extreme outliers that could drive the difference in means and excluded 3 children whose total expenditures exceeded $1 million. Because these 3 children all belonged in the general population group, excluding them as outliers slightly increased the estimated excess use and costs for the ADHD and asthma groups.

Because our general population group included some children with chronic or severe conditions, we also examined mean total expenditures for the subgroup of healthy children. Our primary analyses, however, were based on the entire general population group.

Data were processed and initially analyzed with SAS software (SAS Institute Inc, Cary, NC). We used SUDAAN (Research Triangle Institute, Research Triangle Park, NC)[19] to obtain final estimates with standard errors corrected for the MEPS sampling design.

Until recently, costs associated with caring for children with ADHD have not been studied. Three recent studies have compared health care use and costs between children with ADHD and either children without ADHD or children with asthma.[10-12] These studies have shown that children with ADHD had significantly in-

Table 1. Sociodemographic Characteristics of a Weighted Sample of Children With ADHD or Asthma and the General Pediatric Population*

Characteristic	ADHD (Weighted N = 2 175 755; 3.5%)	Asthma (Weighted N = 3 423 427; 5.5%)	General Population (Weighted N = 56 679 386; 91%)	*P* Value†
Sociodemographic Variables				
Age, y				
5-9	35.9	30.5	31.8	
10-14	44.8	33.1	30.6	<.001
15-20	19.3	36.4	37.7	
Sex, male	77.1	61.2	49.0	<.001
Race				
White	83.3	57.7	65.8	
Black	12.5	23.6	15.6	<.001
Hispanic	3.8	16.4	14.1	
Other	0.4	2.4	4.5	
Parent's education, y				
0-11	13.4	20.9	18.4	
12	38.5	41.0	34.8	.06
≥13	48.1	38.1	46.8	
Marital status, married‡	74.1	70.3	74.0	.59
Access to Care Variables				
Child has usual source of care	95.9	90.7	87.7	<.001
Insurance coverage				
Any private§	72.2	60.4	70.6	
Public	25.2	29.6	16.2	<.001
None	2.6	10.0	13.2	
Income, percentage of federal poverty level				
<100	17.2	27.8	19.3	
100-199	26.4	23.6	21.8	<.05
≥200	56.4	48.6	59.0	
Region of United States				
Northeast	12.6	22.0	18.5	
Midwest	27.9	21.3	23.7	<.01
South	44.8	26.6	35.1	
West	14.7	30.1	22.7	
Urban metropolitan area	77.6	81.8	78.7	.55

*Data given as percentage of subjects unless otherwise indicated. Percentages may not total 100% because of rounding. ADHD indicates attention-deficit/hyperactivity disorder.
†Data were analyzed with a global χ^2 test.
‡Marital status compared with separated, divorced, widowed, or never married.
§Any private insurance in 1996, including the Civilian Health and Medical Program of the Uniformed Services and the Department of Veterans Affairs.

creased overall service use and costs compared with children without ADHD and generally similar costs as children with asthma, with the exception of higher pharmacy costs. However, these studies have limited generalizability because their respective study populations were restricted to youth Medicaid recipients in Pittsburgh, Pa,[10] a health maintenance organization in western Washington State,[11] and a geographically isolated and mostly employed and insured population in Minnesota.[12]

In this study, we used the 1996 Medical Expenditure Panel Survey (MEPS) to derive national estimates of health care use and expenditures for children with ADHD compared with children with asthma and the general pediatric population. We expected that children with ADHD would have similar patterns of health care use and costs as children with asthma but a different pattern of use and higher costs than the general population. We further anticipated that the predominant source of costs associated with ADHD would be prescription costs.

RESULTS

POPULATION CHARACTERISTICS

We identified 165 children with ADHD (representing 2175755 children [3.5%] nationally), 322 with asthma (representing 3423427 children [5.5%] nationally), and 4952 with neither diagnosis (general population) (**Table 1**). The general population group included 215 children (4%) with chronic or severe conditions, such as human immunodeficiency virus, malignancies, diabetes mellitus, sickle cell disease, and congenital anomalies. Of the children with ADHD, only 6 were identified on the basis of prescription records alone. Ten children who had both ADHD and asthma were excluded.

Children with ADHD tended to be younger (133 younger than 15 years [80.7%]), male (127 [77.%]), and white (137 [83.3%]) compared with children with asthma and children in the general population. Although only 7

Table 2. Health Care Use and Costs Among Children With ADHD, Children With Asthma, and the General Pediatric Population*

Health Care Use and Costs	GP (Weighted N = 56 729 567) Mean (SEM)	ADHD (Weighted N = 2 175 755) Mean (SEM)	*P* Value, ADHD vs GP	Asthma (Weighted N = 3 423 427) Mean (SEM)	*P* Value, Asthma vs GP	*P* Value, ADHD vs Asthma
Service use						
Outpatient visits	2.39 (0.090)	5.97 (0.600)	<.001	4.33 (0.410)	<.001	.03
Emergency department visits	0.16 (0.009)	0.23 (0.052)	.15	0.28 (0.042)	.005	.51
Home health visits, d	0.17 (0.080†)	2.08 (2.044†)	.35	0.00 (0.00)	.04	.31
Hospital discharges	0.03 (0.004)	0.04 (0.017†)	.76	0.06 (0.021†)	.13	.29
Prescriptions	2.31 (0.116)	9.88 (1.125)	<.001	6.74 (0.943)	<.001	.03
Expenditures, $						
Total health care	711.91 (40.998)	1150.65 (130.013)	.001	1089.87 (159.523)	.02	.77
Outpatient visits	214.89 (14.430)	416.14 (51.240)	<.001	348.49 (38.400)	.001	.30
Emergency department visits	55.95 (12.977)	145.64 (55.648†)	.12	69.83 (15.035)	.48	.12
Home health visits	8.96 (4.857†)	18.61 (13.287†)	.50	0.00 (0.00)	.07	.16
Hospital stay	148.72 (24.958)	70.33 (37.214†)	.08	223.93 (122.596†)	.55	.23
Prescriptions	52.40 (4.040)	312.49 (30.675)	<.001	175.25 (24.601)	<.001	<.001
Total out-of-pocket	202.23 (10.940)	385.94 (55.254)	.001	245.49 (34.461)	.23	.04

*ADHD indicates attention-deficit/hyperactivity disorder; GP, general pediatric population.
†Relative standard error is ≥30%.

children (4.2%) were reported to have fair or poor physical health, compared with 42 (13.1%) from the asthma group and 119 (2.4%) from the general population, 21 children with ADHD (13%) were reported to have fair or poor mental health, compared with 14 (4.3%) and 129 (2.6%), respectively. One hundred fifty-eight children with ADHD (95.9%) reported having a usual source of care, and they were less likely to be uninsured (4 [2.4%]) or to live in households whose income was below 100% of the federal poverty line (28 [17.0%]). Seventy-four (44.8%) lived in the southern region of the United States.

Twenty-four children with ADHD (14.5%) also had a comorbid condition, such as anxiety, depression, tic disorder, oppositional-defiant and conduct disorder, and learning difficulties.

PATTERNS OF HEALTH CARE USE

As a group, children with ADHD had greater use of outpatient visits and prescriptions than either children with asthma or the general pediatric population (**Table 2**). Children with ADHD had a mean of 6.0 outpatient visits, compared with 4.3 visits for children with asthma ($P<.001$) and 2.4 visits for the general population ($P<.01$). Children with ADHD received an average of 9.9 prescriptions, whereas children with asthma received 6.7 prescriptions ($P<.001$) and children in the general population received 2.3 ($P<.001$). Of the 1600 prescriptions for children with ADHD, 829 (51.8%) were for stimulant medications and another 266 (16.6%) were for medications typically used for psychiatric conditions, such as depression. Children with ADHD did not differ significantly from children in the other 2 groups in the number of ED visits, home health visit days, or hospital discharges.

In this sample, ED visits were a relatively rare event. Although children with asthma had similar average numbers of ED visits in 1996 as children with ADHD (0.3 and 0.2, respectively), the pattern of diagnoses associated with ED visits differed greatly (**Figure 1**). Of the 36 ED visits by 28 children with ADHD, 23 diagnoses (65%) were related to injuries such as lacerations, fractures, and sprains, 6 (16%) were for respiratory illnesses (excluding asthma), and 7 (19%) were for other conditions. For the 79 ED visits by 58 children with asthma, only 20 diagnoses (25%) were related to injuries, whereas 38 (48%) were related to respiratory illness (including asthma) and 21 (27%) were related to other conditions. The 502 children in the general population had 643 ED visits, with 322 diagnoses (50%) related to injuries, 64 (10%) related to respiratory conditions, and 257 (40%) related to other conditions.

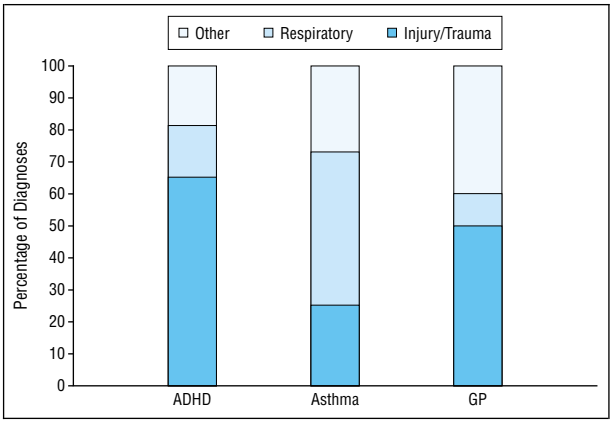

Figure 1. Pattern of diagnoses associated with emergency department visits for children with attention-deficit/hyperactivity disorder (ADHD), children with asthma, and the general pediatric population (GP).

PATTERNS OF HEALTH CARE COSTS

Overall, the 1996 unadjusted mean cost of health care for children with ADHD totaled $1151, significantly higher than the total costs for children with asthma ($1090; $P<.05$) and the general pediatric population ($712; $P<.001$; Table 2). The general population subgroup of healthy children incurred a mean total cost of $661, whereas the subgroup with chronic conditions incurred a mean total cost of $1862.

Table 3. Impact of ADHD, Asthma, and Other Characteristics on Selected Expenditures*

Characteristic	Expenditures, Coefficient (SE)		
	Total	Outpatient	Prescription
ADHD	479.17 (145.77)‡	211.89 (56.22)‡	261.21 (30.50)‡
Asthma	436.91 (173.98)†	152.94 (40.20)‡	126.60 (26.71)‡
Age, 5-9 y	−188.19 (63.68)‡	11.87 (20.70)	−3.17 (8.78)
Age, 15-20 y	378.82 (119.16)‡	125.42 (35.65)‡	24.97 (9.61)‡
Male sex	−81.26 (82.52)	−31.34 (26.44)	7.82 (8.49)
Black race	−287.59 (92.08)‡	−128.63 (23.41)‡	−32.46 (11.06)‡
Hispanic race	−179.46 (93.97)	−36.63 (24.07)	−12.74 (10.22)
Other race	−313.48 (156.92)†	−98.29 (39.74)†	−37.68 (8.85)‡
Income <100% of the federal poverty level	−188.28 (104.22)	−8.19 (31.59)	−5.82 (10.00)
Income 100%-199% of the federal poverty level	−188.60 (96.47)	−33.41 (24.24)	−10.83 (8.22)
Public insurance	67.33 (103.60)	−45.75† (22.97)	10.19 (11.58)
No insurance	383.62 (56.11)‡	147.79 (15.91)‡	24.24 (8.63)‡
Child has usual source of care	364.93 (69.87)‡	124.20 (19.08)‡	45.41 (5.23)‡
Parents married	−20.48 (150.79)	−8.29 (37.91)	10.74 (13.16)
Parent's education, <12 y§	26.87 (79.17)	−23.58 (20.31)	13.19 (10.12)
Parent's education, >12 y§	159.95 (86.30)	66.94 (28.39)†	12.39 (8.99)
Northeastern region	−122.39 (157.08)	58.22 (48.54)	36.84 (13.78)‡
Midwestern region	−21.73 (172.90)	0.97 (41.83)	11.24 (9.55)
Southwestern region	−211.24 (136.75)	−16.99 (32.98)	29.44 (9.66)‡

*All characteristics were assessed while adjusting for the impact of the other characteristics. Total expenditures, $R^2 = 0.037$; outpatient expenditures, $R^2 = 0.032$; and prescription expenditure, $R^2 = 0.063$. ADHD indicates attention-deficit/hyperactivity disorder.
†$P<.05$.
‡$P<.01$.
§Parent's education equals 12 years for the reference group.

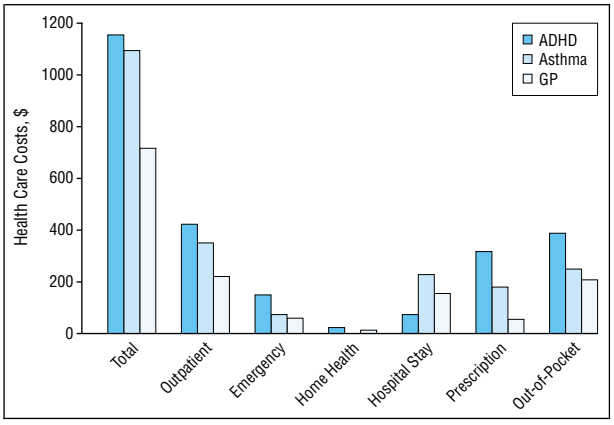

Figure 2. Health care costs by category for children with attention-deficit/hyperactivity disorder (ADHD), children with asthma, and the general pediatric population (GP).

Children with ADHD and a comorbid condition incurred a mean total health care cost of $2367 compared with the mean total cost of $997 for children with uncomplicated ADHD. Because the number of children with comorbid ADHD was small, however, these estimates should be interpreted with caution, and further subgroup analyses were not reliable.

After adjusting for the effects of sex, race, poverty status, insurance type, having a usual source of care, parent's education and marital status, and region of the United States, children with ADHD incurred an excess cost of $479 (95% confidence interval [CI], $193-$765) compared with children in the general population (**Table 3**). Children with asthma had an excess expenditure of $437 (95% CI, $96-$778).

In general, children with ADHD exceeded the other groups across all component costs (outpatient, ED, home health, and prescription) and out-of-pocket expenses, except for hospital stays (**Figure 2**). However, the differences in these costs between children with ADHD and children with asthma were statistically significant only for prescription-related costs and out-of-pocket expenses.

The relative proportions of component costs differed across groups. For children with ADHD, outpatient, prescription, ED, and hospital stay costs accounted for roughly 36%, 27%, 13%, and 6% of total costs, respectively. In contrast, children with asthma had approximately 32% of total expenditures related to outpatient visits, 16% to prescriptions, 6% to ED visits, and 21% to hospital stays. For children in the general population, outpatient, prescription, ED, and hospital stay costs accounted for 30%, 7%, 8%, and 21% of total costs, respectively.

HEALTH CARE USE AND COSTS ASSOCIATED WITH STIMULANT USE

Among children with ADHD, we compared health care use and costs between those who had received a prescription for stimulant medication during 1996 and those who had not (**Table 4**). Not surprisingly, children who had been treated with stimulants had twice the number of outpatient visits and nearly 3 times the number of prescriptions. Similarly, total, outpatient visit, and prescription costs were at least double those of children with ADHD who had not received a prescription for stimulants. Children with and without medication did not differ in their use of and costs related to ED visits.

COMMENT

This study is the first to produce national estimates of health care use and costs for children with ADHD, com-

Table 4. Selected Health Care Use and Costs of Children With ADHD Treated With Stimulants Compared With No Stimulants*

Health Care Use and Costs	Stimulants (n = 114; Weighted N = 1 468 340) Mean (SEM)	No Stimulants (n = 51; Weighted N = 707 414) Mean (SEM)	*P* Value
Service use			
Outpatient visits	7.2 (0.78)	3.5 (0.7)	.002
Emergency department visits	0.3 (0.1)	0.2 (0.1)	.18
Prescriptions	12.4 (1.6)	4.7 (1.0)	<.001
Expenditures, $			
Total health care	1447.39 (172.23)	534.73 (116.01)	<.001
Outpatient visits	512.80 (69.42)	215.49 (39.16)	<.001
Emergency department visits	196.56 (81.83)	39.95 (25.35)	.08
Prescriptions	417.10 (36.49)	95.33 (22.05)	<.001
Total out-of-pocket	449.12 (63.93)	254.81 (87.87)	.08

*ADHD indicates attention-deficit/hyperactivity disorder.

paring them with children with asthma and children in the general population with neither condition. Children with ADHD and children with asthma use substantially more health services than the general childhood population. Correspondingly, health care expenditures for each of these groups exceeds that of the general population by $400 to $500 per year. Despite the generally similar level of use between the 2 chronic conditions, the main sources of ADHD-related costs were outpatient visits, out-of-pocket expenses, and prescriptions. The 3 groups did not differ statistically with respect to ED visit, home health, and hospital stay expenditures.

These results are consistent with previous studies in more specific populations. Using Medicaid claims data for children aged 7 to 20 years in Pittsburgh and surrounding counties, Kelleher et al[10] found that total health care costs for children with ADHD were similar to health care costs for children with asthma, although children with ADHD had 42% higher pharmaceutical costs and 32% more outpatient visits. A retrospective cohort study in a western Washington State managed care organization found that children with ADHD, compared with children without ADHD matched on age and sex, incurred approximately twice the per capita total cost of health care and had 9.9 times more outpatient mental health visits and 1.6 times more primary care visits.[11] The adjusted incremental cost for children with ADHD alone was $375, whereas the adjusted incremental cost for children with ADHD and coexisting mental health disorders was $812. Finally, a population-based birth cohort study in Rochester, Minn, with complete medical and school record data, found that 9-year median costs for children with ADHD were more than double the costs for children without ADHD ($4306 vs $1944).[12] However, these costs did not include prescription or private mental health service–related costs. None of these studies specifically excluded children with chronic or severe conditions from their comparison groups.

Our results for the children with asthma are likewise consistent with previous studies of the economic burden of asthma.[20,21] Using the 1987 National Medical Expenditure Survey, the predecessor to the 1996 MEPS, Lozano et al[20] found that children with asthma had an average of 6.7 ambulatory visits, 0.5 ED visits, and 0.1 hospitalizations and incurred a total cost of $1129. A similar study in a health maintenance organization found that children with asthma averaged 5.8 nonurgent outpatient visits and 11.6 pharmacy fills in 1992. These children incurred approximately $1060 in total health care costs compared with $564 for children without asthma.[21]

Several issues may limit the interpretability of this study. First, the sample sizes for the ADHD and asthma groups were relatively small. Although they are the most common chronic conditions in childhood, these disorders occur at a low enough frequency that general population surveys will include relatively few children unless they are systematically oversampled. This small sample size particularly impairs this study's ability to determine differences in relatively rare events, such as hospitalizations and ED visits, between the 2 condition groups. Although the sample sizes for both asthma and ADHD are relatively small, if the samples themselves are statistically valid, they do establish general patterns of use and expense.

The methodologic concerns about the representativeness of the samples appear minimal. The exclusion of institutionalized and incarcerated youth from the MEPS may affect the ADHD group because children with ADHD are at higher risk for delinquency and psychiatric disorders. Although such children represent only a small proportion of children with ADHD, their consumption of health care services may be significant. The specific challenges of identifying children with ADHD through a national telephone survey may have resulted in underidentification of children with this disorder. Relative to asthma, the stigma of "labeling" a child with ADHD is likely to produce underreporting of this condition, which leads to children with ADHD classified as being in the general population. We used prescription data to enhance our ability to identify children with ADHD; because stimulants are rarely used for other indications, several prescriptions for stimulant medication would indicate a probable diagnosis of ADHD. We found only 6 of the 164 children with ADHD in this sample through the use of stimulant medication alone, which suggests that stigma was not a major impediment to reporting. Use of a computer-assisted telephone interview methodology may also have contributed to some underreporting of asthma cases

because the prevalence of this disorder may be higher in inner-city, disadvantaged communities without consistent telephone access. The ability of families in such communities to participate in the MEPS would thus be limited. This concern is minimized by MEPS procedures, however, because households without a phone are contacted by mail and asked to provide an alternative phone number.[13]

The health services use data in the MEPS derive from parent reports and, thus, may be subject to recall bias. However, much of these data are validated with information from medical and insurance providers. The impact of illness on recall also should not bias the comparisons between children with asthma and children with ADHD. Finally, the data are consistent with the more narrowly focused, claims-based assessments published in the literature.[10-12,21]

The use of medication data as a means of identifying children with ADHD but not children with asthma may result in systematically different severity levels in the different conditions, on the assumption that children treated with medication have a more severe illness than children not so treated. Few children with ADHD in this sample were identified by medication alone. In addition, although our data do indicate that costs are higher for children treated with medication for ADHD, this may simply reflect the medical costs of treatment per se. Few data inform whether use of medication for ADHD is related to severity, or whether it may be more strongly influenced by family and clinician attitudes and values than the characteristics of the child's condition. Furthermore, few children receiving more intensive medication treatment for asthma will be missed by simply using the diagnosis coded in the MEPS. A recent study in an adult managed care population found that while a coded asthma diagnosis had a positive predictive value of 86%, only half the individuals who received asthma medications also had an asthma diagnosis.[16] Finally, different algorithms of asthma medication use have different predictive value for identifying individuals with asthma.[17]

The potential economic burden of ADHD is enormous. Extrapolated across the MEPS-derived 3.5% population prevalence of childhood ADHD, a total expenditure of $1150.65 per child represents an approximately $2.5 billion burden on the health care system. The additional cost attributable to children with this condition relative to the general pediatric population is approximately $1 billion. Our findings, however, significantly underestimate the full extent of health care use and expenditures with this condition, as children with ADHD receive a significant proportion of their care in mental health and school settings. The MEPS is limited to expenditures in medical settings and does not survey psychologists who do not provide care under the supervision of a physician (MD or DO), so the cost of services provided by the school system and by independent psychologists would not be included in our data. Indeed, the cost borne by the school system alone may be substantial because schools need nurses to dispense medication, psychologists to provide psychoeducational testing and counseling, and special education teachers and smaller class sizes to accommodate children with ADHD with comorbidities. Finally, indirect costs, such as decreased work productivity by parents, may be at least as great as the direct costs.

What This Study Adds

Although 3 previous studies have examined the costs associated with care for children with ADHD, this is the first study to use a representative national sample. The findings from this study can then be extrapolated to the entire US population, providing a more valid estimate of the impact of this condition on direct medical expenses.

This study found that children with ADHD incur annual medical expenditures on average $479 more than do children without ADHD (or asthma), or $1.5 billion in additional costs across the childhood population. Efforts to improve child health must begin to focus on ADHD as a source of significant childhood morbidity and health care use.

Conditions such as ADHD have not received the widespread public attention as have "classic" medical conditions, such as asthma. These data suggest that the burden of illness imposed by ADHD, and the direct costs associated with this condition, are roughly of the same magnitude as for asthma. Thus, ADHD deserves similar emphasis in health care and public health efforts to enhance child health.

The high prevalence of ADHD requires that assessment, diagnosis, and management of this disorder take place within the primary care system; the child mental health care system simply does not have the capacity to address a disorder this common. The need for primary care clinicians to address such disorders in this practice has long been recognized.[2,22-25] Nonetheless, primary care clinicians continue to profess discomfort and to lack expertise in this area.[26,27]

Although much research has examined the short-term efficacy of medication and, to a lesser extent, behavioral interventions, only recently have studies begun to address the efficacy of these individual therapies, as well as of combined therapies, over time.[28] Studies have not examined the impact of such treatments on costs and service use, and no studies have yet examined the impact of interventions in real-world settings on outcomes, costs, and use. Such studies have proven to be extremely valuable in developing systems of care for adults with depression and should be designed and implemented for children with ADHD. These real-world interventions also must encompass school-based and mental health care system components but should remain focused on improving systems of primary care. Only through such research can we determine what interventions are needed to improve outcomes for children with this disorder.

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