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RESEARCH ARTICLE

Impact of Family Structure on Stimulant Use among Children with Attention-Deficit/Hyperactivity Disorder

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Objective. To examine the impact of family structure on pharmacologic stimulant use among children with attention-deficit/hyperactivity disorder (ADHD).
Data Source. Nationally representative, population-based sample of the National Health Interview Survey from 1997 to 2003 linked with drug event files from the Medical Expenditure Panel Survey from 1998 to 2005.
Study Design. Stepwise multivariate logistic regression was used to examine the likelihood of stimulant use for each individual during 2 years of observation after adjustment for sociodemographic, health, and family characteristics. Stratified analyses were also conducted to examine whether family characteristics had different impacts within single-mother and dual-parent households.
Principal Findings. Stimulant use varied based on children's sociodemographic and health characteristics. In multivariate analyses, associations between children's household structure, parental education, and stimulant use appeared to be mediated by children's access to care and health status. However, in full multivariate models, there remained a robust positive association between family size and stimulant use.
Conclusions. These findings highlight the influence that nonclinical factors such as family size may have in mediating the use of pharmacologic therapies for children.

Key Words. Attention-deficit/hyperactivity disorder (ADHD), prescription drug use, access to care

Attention-deficit/hyperactivity disorder (ADHD) is common among children and adolescents, with some studies reporting a national prevalence as high as 5–8 percent (Subcommittee on Attention-Deficit/Hyperactivity Disorder, Committee on Quality Improvement 2001). In addition to being common, the disorder is costly. For example, in 1996, more than $1 billion was spent treating this condition or its sequelae among children in the United States (Chan, Zhan, and Homer 2002). The burden of ADHD also extends beyond the immediate clinical costs of the condition, since it may impact academic achievement (Massetti et al. 2008), self-esteem and psychological development (Barber, Grubbs, and Cottrell 2005), and interpersonal relationships with friends and family (Melnick and Hinshaw 1996; Ettner, Frank, and Kessler 1997).

Although behavioral and other nonpharmacologic therapies are often helpful in treating ADHD, pharmacologic treatment with stimulants remains a mainstay of therapy. According to one recent report, approximately 3 percent of U.S. children 18 years of age or younger took stimulants during 2002, representing a total of 2.2 million children (Zuvekas, Vitiello, and Norquist 2006). Stimulant therapy has been demonstrated to reduce core ADHD symptoms of impulsivity and hyperactivity and to maximize more desired functions such as improving interpersonal skills and academic performance and decreasing disruptive behavior (Spencer et al. 1996). However, as with all pharmacotherapies, stimulant use comes with risks, since they are potentially addictive and long-term use may lead to cardiovascular, digestive, endocrine, neurologic, and psychiatric side effects (Guevara et al. 2002; Timimi et al. 2004). These risks, which culminated in a black box warning regarding stimulant use in 2006, are of even greater concern given that many children who do not fulfill formal criteria for ADHD may still receive treatment (Rey 2003). Because of the magnitude, risks, and economic and noneconomic costs of stimulant use, there have been ongoing debates among many stakeholders regarding their appropriate role as a pharmacotherapy for ADHD and related conditions.

Several studies have examined patterns of stimulant use in the United States. For example, Olfson and colleagues used a nationally representative sample to document a steep rise in the use of stimulants from 1987 to 1997 (Olfson et al. 2003), and in another report, to demonstrate important differences in the likelihood of such use based on patients' characteristics, such as greater use among boys than girls and among those with public rather than private insurance (Olfson et al. 2002). Despite the insights from these reports,

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they leave several questions unanswered, including rates of stimulant use among those with a clinical diagnosis of ADHD, as well as the role of nonclinical factors that may mediate the use of pharmacotherapies for this common condition. This latter point is particularly important because there is considerable evidence from other contexts that factors as varied as patients' race (Chan, Zhan, and Homer 2002), sex (Fox and Foster 1999), and geographic region (Chen and Wu 2008) may all influence the use of prescription drugs.

In this report, we examine the association between clinical and nonclinical variables and stimulant use among children with ADHD. We were particularly interested in how individuals' family structure might be associated with stimulant use. There are numerous causal pathways whereby such influence may occur (Chen and Escarce 2006, 2008). For example, stimulant use among children of parents with higher incomes might be greater than in their counterparts due to greater access to treatment, or due to a "substitution effect" whereby the drugs may compensate for lower parental availability due to workplace demands (Urban Institute 2001). Although observational data such as the sources used herein do not allow for precise causal pathways to be articulated, they nevertheless provide an opportunity to consider the role that nonclinical factors may have in influencing the pharmacologic treatment of this common condition. By identifying these factors, our analyses may be relevant both to parents and other caretakers of children with ADHD, as well as providers navigating various management strategies for this common condition.

METHODS

Data and Subjects

We linked data from the 1997–2003 National Health Interview Survey (NHIS) with the 1998–2005 Medical Expenditure Panel Survey (MEPS) to conduct our analyses. We use the NHIS to identify children with ADHD and to gather information regarding subjects except for their prescription drug utilization, which was obtained from the MEPS. By design, MEPS follows a subset of individuals from NHIS for 2 years after their participation in the NHIS. Both sources provide for a nationally representative estimate of the civilian, noninstitutionalized, household population of the United States, although the MEPS consists of a subset of all subjects included in the NHIS.

We selected the NHIS children files for the years 1997 to 2003. Key data elements derived from NHIS included subjects' sociodemographic (age, sex, race, parental education, household income as a fraction of federal poverty line, health insurance, geographic region, and metropolitan area), health (self-reported physical and mental health status, mental disorders, health care use), and family (single-mother versus dual-parent household structure, number of children, number of nonparental adults) characteristics. We adjusted for geographic region and metropolitan area in our models because local market size may play an important role in determining access and use of health care services (Kronick et al. 1993), and we adjusted for paternal education in stratified models to assess whether the father's level of education was associated with stimulant use independent of other covariates. We then linked each NHIS file with corresponding data from the MEPS prescription event files that contain information on individuals' prescription drug use, including number of prescriptions during a given survey round, drug names, NDC codes, and quantities.

We limited our analysis to children 2–17 years of age at the time of the NHIS household interview who were identified as having ADHD based on data derived from NHIS. We excluded children younger than 2 years of age given infrequent stimulant use or ADHD symptoms among children this young, but we retained "pre-schoolers" as prevalence of ADHD and stimulant use among this group has generated sufficient interest among clinicians and researchers (Rappley et al. 1999; Connor 2002). In the NHIS, diagnoses for both mental and nonmental disorders are typically identified through parental report of a doctor or health professional having diagnosed the child with the condition (Division of Health Interview Statistics 2004). By contrast, in the MEPS, these diagnoses are based on patient-reported medical conditions that are subsequently coded into ICD-9 codes linked with records of prescription dispensing in the Prescription Drug Event Files (http://www.meps.ahrq.gov/mepsweb/data_stats/download_data/pufs/h94a/h94adoc.shtml#2726). Since we limited our analyses to subjects with a diagnosis of ADHD, we excluded the approximate 5 percent of subjects who were reported as using stimulants in MEPS but who lacked a diagnosis of ADHD.

Analyses

We defined our primary outcome as the dichotomous use of a stimulant for an individual at any point during the 2 years that each subject was observed. We considered all stimulants with FDA approval that were available in the United

States during the study period, including methylphenidate (e.g., Ritalin®, Concerta®), dexmethylphenidate (Focalin®, Dexedrine®, Dextrostat®), methamphetamine (Desoxyn®), modafinil (Provigil®), and Adderall® (a combination of amphetamine and dextroamphetamine).

First, we used χ^2 and *t*-tests to describe the bivariate association between subjects' sociodemographic, health, and family characteristics and the likelihood of stimulant use. We excluded the 4 percent of children cared for by single fathers and the 3 percent of parentless families, since they comprised a small proportion of the overall sample and estimates and tests based on such a small sample would be very imprecise (Chen and Escarce 2006).

Next, we used logistic regression to estimate the multivariate association between each covariate of interest and stimulant use. We used a forward stepwise process to sequentially develop five multivariate models: (1) first focusing only on family type (single-mother versus dual-parent), since this family characteristic has been demonstrated to be a predictor in determining a number of economic and sociologic outcomes as well as use of health care resources (Urban Institute 2001); (2) adding mother's education; (3) adding number of other children in the family, presence of nonparental adults, and demographic characteristics (sex, age, and race); (4) adding income (measured as percent of federal poverty level), insurance, and health status; and (5) concluding by adjusting for geographic region and metropolitan area. This process allowed for us to observe how much the estimated coefficients were sensitive to the model specifications, and it also allowed for us to explore some possible pathways by which these variables may influence choice of prescription drug use for children with ADHD. In these analyses, we included variables demonstrated to be important determinants of health care use and outcomes (e.g., household income) and those statistically significant on bivariate analysis. After analyzing the whole sample, we stratified our analysis in two different samples by dual-parent and single-mother families to check the sensitivity of our findings from the previous models. We reasoned that single-mother families often have different patterns of health and health care utilization than dual-parent households (Chen and Escarce 2006), and stratification allowed for us to examine whether some features of household structure (e.g., maternal education) might differ among single-mother versus dual-parent households.

All models were checked for overall validity. We examined the goodness of fit for the model using both Pearson and Hosmer–Lemeshow χ^2 tests. We also performed sensitivity analyses by detecting possible influential observations and outliers. All analyses were done using Stata®, version 10.1 (Standard Edition, College Station, TX).

RESULTS

Subject Characteristics

Table 1 describes the characteristics of the entire sample of children diagnosed with ADHD. Overall, of all children with a diagnosis of ADHD during the years examined, approximately 71 percent were male, 81 percent were white, 20 percent had at least one additional mental illness, and 51 percent had seen a mental health professional during the year before the interview. There was considerable variation in family structure among the group. For example, about one-third (36 percent) were from single-mother households, and family size varied with 43 percent having three or fewer members, 40 percent with four members, and 17 percent with five or more members.

Bivariate Analyses

On bivariate analyses, several sociodemographic, health, and family characteristics were associated with the likelihood of stimulant use (Table 2). For example, stimulant use was greater among those aged 2–6 years (56 percent) than among those aged 7–11 years (42 percent) or 12–17 years of age (27 percent). Consistent with prior reports examining national trends in stimulant use regardless of diagnosis, among those with ADHD, stimulant use was modestly more common among boys (38 percent) than girls (33 percent), although this difference was not statistically significant. There was marked variation in the likelihood of stimulant use based on self-reported physical health, with those reporting excellent health having a much higher association of stimulant use (45 percent) than those reporting fair (27 percent) or poor (13 percent) health. The bivariate association between stimulant use and self-reported mental health also exhibited a very similar pattern (see Table 2).

Multivariate Analyses among All Subjects

Table 3 depicts the multivariate association between subjects' sociodemographic, health, and family characteristics and the likelihood of stimulant use. In stepwise models, there was a consistent association between children's sex and age and stimulant use. For example, boys were more likely to use stimulants than girls, and children in the oldest age group were less likely to use stimulants than their younger counterparts.

Table 1: Subject Characteristics (*N* = 11,048; Annualized Population-Weighted Sample Size 12.6 Million)

	*%, Population Weighted**
Male sex	71
Age (years)	
2–6	12
7–11	44
12–17	45
Race	
White	81
Black	11
Hispanic	7
Other	1
Mother's education, years	
Less than high school diploma	16
High school diploma	24
Some college or more	60
Father's education, years	
Less than high school diploma	9
High school diploma	19
Some college or more	37
Unknown	36
Single-mother family	36
Number of additional children	
None	48
One	38
Two or more	11
Nonparental adults in household	
No	68
Yes	32
Income	
<125% of federal poverty level (FPL)	18
125%–400% of FPL	41
400% or more of FPL	26
Unknown	14
Physical health	
Excellent	58
Fair or poor	43
Mental health	
Excellent	43
Fair	52
Poor	5
Other mental illness	20
Seen a mental health professional	51
Insurance status	
Private	72
Public	26
None	2

*Column totals may not add to 100% because of rounding.

Table 2: Bivariate Correlates of Stimulant Use among Children with ADHD ($N = 11{,}048$)

	N	*Annualized N (Millions)*	*% Using Stimulants*	*p-Value**
Sociodemographic characteristics				
Age (years)				
2–6	1,474	1.5	56	<.01
7–11	4,664	5.5	42	
12–17	4,910	5.6	27	
Sex				
Male	3,174	3.6	38	.21
Female	7,874	8.9	33	
Race				
White	7,742	10.2	37	.05
Black	1,538	1.3	39	
Hispanic	1,621	0.9	29	
Other	147	0.2	42	
Insurance status				
Private	6,742	9.1	37	.76
Public	4,057	3.3	37	
None	249	0.2	32	
Metropolitan status				
No	2,362	2.4	32	<.01
Yes	8,686	10.1	38	
Region				
Northeast	2,088	2.4	35	<.01
Midwest	1,916	2.3	41	
South	5,801	6.7	35	
West	1,243	1.2	45	
Health characteristics				
Physical health				
Excellent	5,947	7.2	45	<.01
Fair	4,604	4.9	27	
Poor	497	0.5	13	
Mental health				
Excellent	4,471	5.4	45	<.01
Fair	5,933	6.5	31	
Poor	644	0.6	19	
Other mental illness				
No	8,636	10.0	39	.07
Yes	2,412	2.6	28	
Seen a mental health professional				
No	5,375	6.1	43	<.01
Yes	5,673	6.5	32	
Family characteristics				
Mother's education, years				
Less than high school diploma	2,294	2.0	36	.74

continued

Table 2. *Continued*

	N	*Annualized N (Millions)*	*% Using Stimulants*	*p-Value**
High school diploma	2,949	3.0	36	
Some college or more	5,805	7.5	38	
Father's education, years				
Less than high school diploma	1,180	1.1	33	.71
High school diploma	2,025	2.4	38	
Some college or more	3,357	4.6	39	
Unknown	22	0.0	41	
Number of additional children				
None	4,885	6.1	31	<.01
One	4,125	4.7	40	
Two or more	2,038	1.8	47	
Nonparental adults in household				
No	7,700	8.6	38	<.01
Yes	3,348	4.0	34	
Family types				
Dual-parent	6,584	8.1	38	.22
Single-mother	4,464	4.5	35	
Income as % of federal poverty level				
<125%	3,120	2.3	35	<.01
125%–400%	3,956	5.2	35	
400% or more	2,448	3.3	37	
Unknown	1,524	1.7	43	

*All comparisons performed using population weights.

The association between children's family characteristics and stimulant use varied. Children from single-mother households were less likely (OR 0.74, CI 0.68–0.81) to use stimulants in models adjusted for subjects' maternal education, family size, and demographic characteristics. The difference remained somewhat robust after adjusting for subjects' household income, insurance, and health status (OR 0.89, CI 0.80–0.99). Similarly, the finding of greater odds of stimulant use among children with college-educated mothers (OR 1.18, CI 1.06–1.33) also diminished after adjustment for variables that might reflect health status and access to care (OR 0.91, CI 0.80–1.04). By contrast, there was a statistically significant and plausible dose–response association between number of other children in the family and likelihood of stimulant use in all models. In the final model, children with ADHD from families with one (OR 1.32, CI 1.20–1.45) or two or more (OR 1.77, CI 1.56–2.00) additional children were more likely to use stimulants than families with a single child.

Table 3: Multivariate Logistic Regression Results with Stimulant Use as Dependent Variable ($N = 11{,}048$)

	(1) *Unadjusted*	*(2)* *(1)+Mother's Education*	*(3)* *(2)+Family Size and Demographic Characteristics*	*(4)* *(3)+Income, Insurance and Health Status*[†]	*(5)* *(4)+Geographic Characteristics*
Household structure					
Single-mother	0.87 (0.81–0.95)**	0.90 (0.83–0.98)*	0.74 (0.68–0.81)**	0.88 (0.80–0.98)*	0.89 (0.80–0.99)*
Two parent	Ref	Ref	Ref	Ref	Ref
Mother's education					
Less than high school diploma		Ref	Ref	Ref	Ref
High school diploma		1.09 (0.97–1.23)	1.21 (1.07–1.37)**	1.01 (0.88–1.16)	1.00 (0.88–1.15)
Some college or more		1.15 (1.03–1.28)*	1.18 (1.06–1.33)**	0.92 (0.81–1.06)	0.91 (0.80–1.04)
Number of additional children					
None			Ref	Ref	Ref
One			1.31 (1.19–1.44)**	1.33 (1.21–1.46)**	1.32 (1.20–1.45)**
Two or more			1.59 (1.42–1.79)**	1.80 (1.59–2.03)**	1.77 (1.56–2.00)**
Nonparental adults in household					
No			Ref	Ref	Ref
Yes			1.10 (1.00–1.21)	1.03 (0.94–1.14)	1.01 (0.92–1.12)
Sex					
Male			1.20 (1.09–1.31)**	1.18 (1.08–1.30)**	1.17 (1.06–1.29)**
Female			Ref	Ref	Ref
Age group (years)					
2–6			Ref	Ref	Ref
7–11			0.74 (0.65–0.84)**	0.78 (0.68–0.89)**	0.79 (0.69–0.90)**
12–17			0.36 (0.31–0.41)**	0.40 (0.35–0.46)**	0.41 (0.35–0.47)**
Race					
White			Ref	Ref	Ref

continued

Table 3. *Continued*

	(1) Unadjusted	(2) (1)+Mother's Education	(3) (2)+Family Size and Demographic Characteristics	(4) (3)+Income, Insurance and Health Status[†]	(5) (4)+Geographic Characteristics
Black			1.27 (1.13–1.44)**	1.36 (1.20–1.54)**	1.33 (1.17–1.51)**
Hispanic			0.66 (0.58–0.74)**	0.78 (0.68–0.89)**	0.75 (0.65–0.86)**
Other			1.37 (0.96–1.95)	1.55 (1.06–2.26)*	1.44 (0.99–2.10)
Income as % of federal poverty level					
<125%				Ref	Ref
125%–400%				1.11 (0.97–1.26)	1.09 (0.96–1.25)
400%				1.34 (1.14–1.57)**	1.31 (1.12–1.54)**
Unknown				1.02 (0.87–1.20)	1.03 (0.88–1.20)
Insurance coverage					
Private				Ref	Ref
Public				1.14 (1.02–1.28)*	1.16 (1.03–1.31)*
Uninsured				0.82 (0.61–1.11)	0.80 (0.59–1.09)
Seen a mental health professional					
No				Ref	Ref
Yes				0.80 (0.73–0.88)**	0.79 (0.72–0.86)**
Physical health					
Excellent				Ref	Ref
Fair				0.59 (0.54–0.65)**	0.60 (0.55–0.67)**
Poor				0.19 (0.13–0.26)**	0.19 (0.14–0.27)**
Mental health					
Excellent				Ref	Ref
Fair				0.79 (0.71–0.87)**	0.79 (0.71–0.87)**
Poor				0.48 (0.38–0.61)**	0.49 (0.39–0.62)**

Other mental illness		
No	Ref	Ref
Yes	0.81 (0.73–0.91)**	0.84 (0.75–0.94)**
Metro resident		
No		Ref
Yes		1.07 (0.96–1.20)
Region		
Northeast		Ref
Midwest		1.21 (1.05–1.40)**
South		1.00 (0.89–1.13)
West		1.32 (1.13–1.55)**

Ref = referent; 95% confidence intervals in parentheses;

*Significant at 5%;

**Significant at 1%.

†Self-reported physical and mental health status, presence of other mental illness(es) and whether the child was seen by a mental health professional.

Multivariate Predictors of Stimulant Use Stratified by Single-Mother Versus Dual-Parent Households

Table 4 depicts the multivariate association between family characteristics and stimulant use among children in dual-parent households. We did not find any statistical association between maternal or paternal education and stimulant use among children with ADHD. In addition, as with the nonstratified multivariate model (Table 3), there was a persistent, statistically significant association between number of children in the family and stimulant use, with children from the largest families having greater than a 2.5-fold odds of using stimulants compared with families with a single child (OR 2.57, CI 1.77–3.75).

Table 4 also depicts analyses limited to children in single-mother households. In the model controlling for all covariates, maternal education did not show any statistically significant association with stimulant use among children with ADHD. Families with additional children exhibited higher odds of receiving stimulant compared with the families with no other child.

DISCUSSION

Although numerous studies have examined national trends in stimulant use, including sociodemographic correlates of such use, few if any have explored the role that family structure may play in mediating the use of these commonly prescribed therapies. In this analysis of rigorously collected data from the NHIS and the MEPS, we found that associations among children's household structure, parental education, and stimulant use appeared to be mediated by children's access to care and health status. By contrast, we found a robust association between family size and stimulant use, with children from larger families significantly more likely to be using stimulants than their counterparts.

These findings are important because ADHD among children is common and costly, and stimulant use remains a mainstay of pharmacotherapy. Although pharmacoepidemiologic studies of stimulant use, and indeed other psychotropic and nonpsychotropic use, often explore the association between patterns of drug use and subject demographic characteristics and health care utilization, many fewer consider how family structure may impact such use. As with other important social determinants of health, household characteristics may be influential in mediating use of treatments through numerous pathways, including through affecting parental availability as well as cultural beliefs (Zygmunt et al. 2002) and expectations for children.

Table 4: Stepwise Patient-Weighted Regression Analysis of Stimulant Use for Children Stratified by Family Type

	(1) *Unadjusted*	*(2)* *(1)+Income And Insurance*	*(3)* *(2)+Health Status and Use*†	*(4)* *(3)+Demographic Characteristics*‡
Dual-parent families (N = 6,562)				
Mother's education				
Less than high school diploma	Ref	Ref	Ref	Ref
High school diploma	1.01 (0.74–1.37)	0.88 (0.73–1.05)	0.84 (0.65–1.09)	0.91 (0.78–1.07)
Some college or more	1.18 (0.90–1.56)	1.08 (0.71–1.65)	1.00 (0.82–1.24)	1.07 (0.94–1.22)
Number of additional children				
None	Ref	Ref	Ref	Ref
One	1.34 (1.00–1.80)	1.39 (1.14–1.68)**	1.44 (1.14–1.83)**	1.23 (1.02–1.48)*
Two or more	2.17 (1.66–2.84)**	2.42 (1.76–3.32)**	2.87 (2.22–3.72)**	2.57 (1.77–3.75)**
Nonparental adults in household				
No	Ref	Ref	Ref	Ref
Yes	0.83 (0.71–0.96)*	0.85 (0.70–1.03)	0.83 (0.70–0.98)*	1.03 (0.92–1.16)
Single mother families (N = 4,464)				
Mother's education				
Less than high school diploma	Ref	Ref	Ref	Ref
High school diploma	1.02 (0.87–1.20)	0.89 (0.75–1.05)	0.73 (0.60–0.88)**	0.96 (0.65–1.41)
Some college or more	0.84 (0.63–1.12)	0.66 (0.46–0.95)*	0.56 (0.34–0.93)*	0.53 (0.25–1.14)
Number of additional children				
None	Ref	Ref	Ref	Ref
One	1.59 (1.04–2.43)*	1.60 (1.15–2.23)**	1.71 (1.35–2.16)**	1.78 (1.41–2.24)**
Two or more	1.58 (1.05–2.37)*	1.71 (1.24–2.37)**	1.86 (1.27–2.73)**	1.82 (1.17–2.84)*
Nonparental adults in household				
No	Ref	Ref	Ref	Ref
Yes	1.01 (0.90–1.14)	1.06 (0.90–1.25)	1.14 (0.98–1.34)	1.16 (0.95–1.42)

Note. 95% confidence intervals in parentheses.

*Significant at 5%; **significant at 1%.

†Self-reported physical and mental health status, presence of other mental illness(es), and whether the child was seen by a mental health professional.

‡Demographic characteristics include age, sex and race, MSA resident status, and MEPS regions; for analysis of dual-parent families, father's level of education included in specifications (2)–(4).

Our findings build on the work of Chen and Escarce (2006), who explored the impact of family structure on ambulatory visits and prescription medicine use as well as the use of office visits and prescriptions among children with asthma (Chen and Escarce 2008). Other work has examined the association between the number of children within a household and the likelihood of immunization, and this work suggests that the likelihood of vaccine receipt decreases as family size increases (Bates and Wolinsky 1998). However, among children with ADHD we find that a larger family size is associated with a greater, rather than a lesser, likelihood of stimulant use. This finding suggests the various pathways whereby a sociologic determinant of health care use, such as having additional child(ren) in the family, may be operative. For example, when considering overall resource use, having other children in the family may serve as a resource constraint and therefore translate into fewer resources that are available to support health care utilization for any one member, even after accounting for potentially confounding intervening variables such as income (Downey 2001). By contrast, in the context of psychiatric illness among children such as ADHD, the impact of this may be outweighed by other factors, such as the greater cost of not treating a child's condition as the potential of a greater number of children may lead to more disruptive behavioral manifestations of ADHD.

Prior work indicates that children from dual-parent families have different cognitive, educational, and behavioral outcomes (McLanahan and Sandefur 1994) when compared with children from single-parent families, and children from single-parent households are constrained economically and prone to resource constraint (Chen and Escarce 2006, 2008). Our analyses also suggests that this aspect of family structure is associated with stimulant use as children from single-mother families have the lower odds of stimulant use compared with the children from dual-parent families. Our results are also consistent with prior work demonstrating higher stimulant use among boys, children who are publicly insured (Zuvekas, Vitiello, and Norquist 2006), and non-Hispanics (Cuffe, Moore, and McKeown 2009); these differences likely accounted for a combination of individual, provider, and health system factors.

Our findings have implications for clinicians, researchers, and policy makers. For clinicians who prescribe stimulants to treat patients with ADHD, our results highlight how the number of children in a family may impact the burden of ADHD and cost associated with behavioral symptoms of this common condition. Our findings also provide an opportunity to consider the synergistic contribution that nonpharmacologic therapies can have in helping to reduce children's core behavioral and cognitive symptoms. For researchers and policy makers, our analysis highlights some of the various pathways whereby family characteristics may influence pharmacologic use, and it suggests that while some characteristics (e.g., single-household versus dual-household families) may mediate use indirectly through impacting access to care or other intervening variables, other features of family characteristics may have more of a direct impact on prescription drug use in this setting. Interventions to reduce the parenting demands among parents of children with ADHD within large families may be one helpful method to decrease the need for pharmacotherapies in this setting.

Our study has several limitations. First, our data do not provide more detailed information regarding the severity of ADHD symptoms; this data would be of interest to see if it provided additional explanatory power estimating predictors of stimulant use. Second, given insufficient sample size to derive meaningful estimates, we were unable to examine treatment patterns within single-father families or families where both parents are absent, and our data does not include children who are institutionalized. Also, data did not allow us to identify some specific types of families such as nuclear versus blended families, which may have important implications for stimulant use. Third, given the observational nature of this data, the associations that we describe such as greater stimulant use among children of larger families may not be causal, and we are unable to adjust for other factors (e.g., parental age, birth order) that may be influential in determining health care use in this setting. Finally, our study was not designed to examine characteristics associated with stimulant use among those without a diagnosis of ADHD.

CONCLUSIONS

Although pharmacoepidemiologic studies commonly consider how readily available sociodemographic characteristics, such as patients' age or sex, are associated with prescription drug use, many fewer have considered the role that demographic or socioeconomic determinants such as family characteristics may play in predicting the use of pharmacotherapies. There are numerous pathways whereby these nonclinical factors may influence prescription drug use, and as our work and that of others suggests, the magnitude and direction of these pathways may differ in different clinical contexts. Among families with children who have ADHD, family size appears to be an important factor in increasing the likelihood of pharmacologic treatment with stimulants.

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References

Barber, S., L. Grubbs, and B. Cottrell. 2005. "Self-Perception in Children with Attention Deficit/Hyperactivity Disorder." *Journal of Pediatric Nursing* 20: 235–45.

Bates, A.S, and F. D. Wolinsky. 1998. "Personal, Financial, and Structural Barriers to Immunization in Socioeconomically Disadvantaged Urban Children." *Pediatrics* 101: 591–6.

Chan, E., C. Zhan, and C. J. Homer. 2002. "Health Care Use and Costs for Children with Attention-Deficit/Hyperactivity Disorder: National Estimates from the Medical Expenditure Panel Survey." *Archives of Pediatrics and Adolescent Medicine* 156: 504–11.

Chen, A. Y., and J. J. Escarce. 2006. "Effects of Family Structure on Children's Use of Ambulatory Visits and Prescription Medications." *Health Service Research* 41: 1895–914.

———. 2008. "Family Structure and the Treatment of Childhood Asthma." *Medical Care* 46: 174–84.

Chen, A. Y., and S. Wu. 2008. "Dispensing Pattern of Generic and Brand-Name Drugs in Children." *Ambulatory Pediatrics* 8: 189–94.

Connor, D. F. 2002. "Preschool Attention Deficit Hyperactivity Disorder: A Review of Prevalence, Diagnosis, Neurobiology, and Stimulant Treatment." *Journal of Developmental and Behavioral Pediatrics* 23 (1 Suppl): S1–9.

Cuffe, S. P., C. G. Moore, and R. McKeown. 2009. "ADHD and Health Services Utilization in the National Health Interview Survey." *Journal of Attention Disorder* 12 (4): 330–40.

Division of Health Interview Statistics. 2004. National Health Interview Survey (NHIS) Public Use Data Release NHIS Survey Description National Center for Health Statistics Hyattsville, MD [accessed on June 2, 2009]. Available at http://www.cdc.gov/nchs/data/nhis/srvydesc.pdf

Downey, D. B. 2001. "Number of Siblings and Intellectual Development: The Resource Dilution Explanation." *American Psychologist* 56 (6/7): 497–504.

Ettner, S. L., R. G. Frank, and R. C. Kessler. 1997. "The Impact of Psychiatric Disorders on Labor Market Outcomes." *Industrial and Labor Relations Review* 51 (1): 64–81.

Fox, M. H., and C. H. Foster. 1999. "Gender, Ethnic, and Geographic Variations in Psychotropic Drug Use among Children Enrolled in Medicaid." *Journal of Gender, Culture, and Health* 4: 293–305.

Guevara, J., P. Lozano, T. Wickizer, L. Mell, and H. Gephart. 2002. "Psychotropic Medication Use in a Population of Children Who Have Attention-Deficit/Hyperactivity Disorder." *Pediatrics* 109: 733–9.

Kronick, R., D. C. Goodman, J. Wennberg, and E. Wagner. 1993. "The Marketplace in Health Care Reform. The Demographic Limitations of Managed Competition." *New England Journal of Medicine* 328 (2): 148–52.

Massetti, G. M., B. B. Lahey, W. E. Pelham, J. Loney, A. Ehrhardt, S. S. Lee, and H. Kipp. 2008. "Academic Achievement over 8 Years among Children Who Met Modified Criteria for Attention-Deficit/Hyperactivity Disorder at 4–6 Years of Age." *Journal of Abnormal Child Psychology* 36: 399–410.

McLanahan, S., and G. Sandefur. 1994. *Growing Up with a Single Parent: What Hurts, What Helps.* Cambridge, MA: Harvard University Press.

Melnick, S. M., and S. P. Hinshaw. 1996. "What They Want and What They Get: The Social Goals of Boys with ADHD and Comparison Boys." *Journal of Abnormal Child Psychology* 24: 169–85.

Olfson, M., M. J. Gameroff, S. C. Marcus, and P. S. Jensen. 2003. "National Trends in the Treatment of Attention Deficit Hyperactivity Disorder." *American Journal of Psychiatry* 160: 1071–7.

Olfson, M., S. C. Marcus, M. M. Weissman, and P. S. Jensen. 2002. "National Trends in the Use of Psychotropic Medications by Children." *Journal of American Academy of Child Adolescent Psychiatry* 41: 514–21.

Rappley, M. D., P. B. Mullan, F. J. Alvarez, I. U. Eneli, J. Wang, and J. C. Gardiner. 1999. "Diagnosis of Attention-Deficit/Hyperactivity Disorder and Use of Psychotropic Medication in Very Young Children." *Archives of Pediatrics and Adolescent Medicine* 153 (10): 1039–45.

Rey, J. M. 2003. "Are Psychostimulant Drugs being Used Appropriately to Treat Child and Adolescent Disorders?" *British Journal of Psychiatry* 182: 284–6.

Spencer, T., J. Biederman, T. Wilens, M. Harding, D. O'Donnell, and S. Griffin. 1996. "Pharmacotherapy of Attention-Deficit Hyperactivity Disorder across the Life Cycle." *Journal of American Academy of Child and Adolescent Psychiatry* 35: 409–32.

Subcommittee on Attention-Deficit/Hyperactivity Disorder, Committee on Quality Improvement. 2001. "Clinical Practice Guideline: Treatment of the School-Aged Child with Attention Deficit Hyperactivity Disorder." *Pediatrics* 108: 1033–44.

Timimi, S., J. Moncrieff, J. Jureidini, J. Leo, D. Cohen, C. Whitfield, D. Double, J. Bindman, H. Andrews, E. Asen, P. Bracken, B. Duncan, M. Dunlap, G. Albert, M. Green, T. Greening, J. Hill, R. Huws, B. Karon, B. Kean, M. McCubbin,

B. Miatra, L. Mosher, S. Parry, S. DuBose Ravenel, D. Riccio, R. Shulman, J. Stolzer, P. Thomas, G. Vimpani, A. Wadsworth, D. Walker, N. Wetzel, and R. White. 2004. "A Critique of the International Consensus Statement on ADHD." *Clinical Child and Family Psychology Review* 7: 59–63.

Urban Institute. 2001. "Honey, I'm Home" [accessed January 6, 2001]. Available at http://www.urban.org/publications/310310.html

Zuvekas, S. H., B. Vitiello, and G. S. Norquist. 2006. "Recent Trends in Stimulant Medication Use among U.S. Children." *American Journal of Psychiatry* 163: 579–85.

Zygmunt, A., M. Olfson, C. A. Boyer, and D. Mechanic. 2002. "Interventions to Improve Medication Adherence in Schizophrenia." *American Journal of Psychiatry* 159 (10): 1653–64.