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FAMILY STRUCTURE AND THE TREATMENT OF CHILDHOOD ASTHMA

Alex Y. Chen, MD, MSHS
José Escarce, MD, PhD

ABSTRACT

Background: Family structure is known to influence children's behavioral, educational, and cognitive outcomes, and recent studies suggest that family structure affects children's access to health care as well. However, no study has addressed whether family structure is associated with the care children receive for particular conditions or with their physical health outcomes.

Objective: To assess the effects of family structure on the treatment and outcomes of children with asthma.

Methods: Our data sources were the 1996-2003 Medical Expenditure Panel Survey (MEPS) and the 2003 National Survey of Children's Health (NSCH). The study samples consisted of children 2-17 years of age with asthma who lived in single-mother or two-parent families. We assessed the effect of number of parents and number of other children in the household on office visits for asthma and use of asthma medications using negative binomial regression, and we assessed the effect of family structure on the severity of asthma symptoms using binary and ordinal logistic regression. Our regression models adjusted for sociodemographic characteristics, parental experience in child-rearing and in caring for an asthmatic child and, when appropriate, measures of children's health status.

Results: Asthmatic children in single-mother families had fewer office visits for asthma and filled fewer prescriptions for controller medications than children with two parents. In addition, children living in families with three or more other children had fewer office visits and filled fewer prescriptions for reliever and controller medications than children living with no other children. Children from single-mother families had more health difficulties from asthma than children with two parents, and children living with two or more other children were more likely to have an asthma attack in the past 12 months than children living with no other children.

Conclusions: For children with asthma, living with a single mother and the presence of additional children in the household are associated with less treatment for asthma and worse asthma outcomes.

Alex Y. Chen, MD, MSHS
4650 Sunset Blvd. MS #30
Los Angeles, CA 90027
achen@chla.usc.edu

José Escarce, MD, PhD
UCLA Med-GIM-HSR
911 Broxton Place
Box 951736
Los Angeles, CA 90095-1736
and NBER
jescarce@mednet.ucla.edu

Numerous studies have linked children's well-being to family structure, including the number of parents and children in the household.[1-5] Children in single-parent households are more likely than children with two parents to be poor, experience food insecurity, and have limited social and economic resources.[1,6] Children growing up in single-parent households also have worse educational outcomes compared with children from two-parent households.[1] Additionally, social scientists have consistently documented an inverse relationship between the number of children in the household and children's intellectual development and educational achievement.[2, 4-5, 7-9] Blake[3] has posited that parental resources are finite and that each additional child in the family represents time and energy drawn away from parents, in effect "diluting" parental resources and resulting in worse outcomes for each child.[3-5, 7-10]

To date, only a few studies have examined the effect of family structure on children's health care.[11] Cafferata and Kasper[12] found that healthy children in single-mother families had more physician visits during the year than children in two-parent families. Heck and Parker[13] found that children in single-mother and in two-parent families were equally likely to have a physician visit at high levels of maternal education, whereas at low levels of maternal education children of single mothers were more likely to have a visit. By contrast, Cunningham and Hahn[14] reported lower health care use for children from single-mother households, and two other studies found slight or no differences between single-mother families and two-parent families in physician visits.[15-16] In the only study to examine the effect of number of children, Chen and Escarce[16] found that children living with several other children had fewer visits and were less likely to use prescription drugs than children living with no other children. Whether these utilization differences have consequences for

children's health is unknown, however, because no study has assessed the effect of family structure on children's health outcomes.

To bridge this gap, we assess the effect of family structure on the treatment and outcomes of children with asthma. Asthma is one of the most prevalent chronic conditions in children.[17-19] It is estimated that 5 million children suffer from asthma and that asthma accounts for more than 200,000 pediatric hospitalizations per year.[17, 19] Previous studies have shown that control of asthma symptoms and asthma outcomes are related to sociodemographic factors.[17, 20] We bring this literature and the literature on family structure and children's well-being together by examining the effect of number of parents and number of other children in the household on asthmatic children's visits, their use of asthma medications, and measures of the severity of their asthma symptoms using nationally representative samples of children.

METHODS

Conceptual Framework

Our conceptual framework posits that children are dependent on their parents to seek and obtain adequate treatment for their medical conditions, and that attributes of the children, parents, and family influence the health care children receive. Consistent with the literature on access to and demand for care, the care children receive for asthma is expected to be affected by children's age, sex, race and ethnicity, and health status; insurance coverage; family income; location of residence (e.g., urban versus rural); parental education; and child-rearing experience. Family structure is expected to influence children's care as well. Single mothers may have less social support and experience greater stress and time demands than

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two-parent couples, impairing their ability to meet their children's health care needs.[1, 11, 13] More children in the family may dilute the time and energy that parents can devote to any particular child.[3-5]

We also posit that the care children receive for their medical conditions influences their health outcomes. In particular, if family structure affects the adequacy of children's treatment for asthma, then those dimensions of family structure associated with less adequate treatment are expected to be associated with more severe asthma symptoms.

Data Sources

The sources of data for the study were the 1996-2003 Medical Expenditure Panel Survey Household Component (MEPS-HC) and the 2003 National Survey of Children's Health (NSCH). The MEPS-HC is a nationally representative survey on the use of health care conducted by the Agency for Healthcare Research and Quality.[21] We used the MEPS-HC to study the effect of family structure on the use of asthma care by linking the MEPS-HC Full Year Consolidated Data Files, Medical Conditions Files, and Event Files for the study years. The Full Year Consolidated Data Files provided information on each subject's sociodemographic characteristics, insurance coverage, and health status.[22-28] The Medical Conditions Files contained self- or parent-reported diagnoses. The Event Files contained detailed event-level information, including diagnoses, for each office-based medical provider visit and prescribed medication.

The NSCH is a cross-sectional, nationally representative telephone survey sponsored by the Maternal and Child Health Bureau and conducted by the National Center for Health Statistics.[29-30] The NSCH interviewed 102,353 households with children younger than 18

years of age between January 2003 and July 2004. The NSCH was designed to produce national and state-level prevalence data for a number of physical and behavioral health indicators for children. For our purpose, it identified children who had been diagnosed with asthma and elicited information on the frequency of asthma attacks and the severity of health difficulties related to asthma (see below). We used the NSCH to study the effect of family structure on children's asthma outcomes.

Study Samples

Due to the clinical ambiguity in diagnosing asthma in very young children, we restricted our study sample to children 2-17 years of age in both the MEPS and the NSCH who had been told by a health professional that they had asthma. As described below, we only included children living in two-parent families or in single-mother families. The 1996-2003 MEPS included 2,657 such children, and the 2003 NSCH included 11,177 such children.

Family Structure Variables

MEPS's reporting unit is a family-based entity defined as a person or group of persons living in the same dwelling who are related by blood, marriage, adoption, foster care, or other family associations.[22-28] For this study, we defined a child's family as the people, including other children, in the same reporting unit. We defined two-parent families as families where both the father and the mother (biological, adopted, or step) of the subject child were living with the child. Correspondingly, we defined single-mother families as families where the

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child's mother was living with the child but the father was absent. Due to their small

numbers, we excluded children living in single-father families.

The NSCH collapsed family structure types into four categories in order to protect the

confidentiality of children whose families had unique characteristics.[30] The categories are: (1)

two-parent households that include a biological or adoptive mother and a biological or

adoptive father; (2) two-parent households but with at least one step-parent; (3) one-parent

households with a biological, adoptive, or step mother but no father of any type present; and

(4) all other family types. To match the MEPS definitions, we designated children in the first

two categories as having two-parent families and children in the third category as living in

single-mother families. We excluded other family types.

Classification of Asthma Medications

The control of asthma symptoms and the long-term course of the disease are largely

determined by the adequacy of treatment with prescription medications. Based on Guidelines

for the Diagnosis and Management of Asthma (NHLBI/NAEPP),[31] we counted and

categorized prescribed medications for asthma in MEPS as "Reliever Medications,"

"Controller Medications," and "Oral Steroids." Reliever medications offer immediate relief

of asthma symptoms but do not alter the fundamental course of the disease. This category

consists mainly of inhaled short-acting β_2-agonists. Controller medications do not provide

immediate relief of symptoms, but rather prevent symptoms from developing and, more

important, modify the long-term course of the disease. This category includes inhaled

steroids, long-acting β_2-agonists, leukotriene modifiers, and cromolyn derivatives. Current

guidelines indicate that all but patients with mild intermittent asthma should receive controller

medications routinely.[31] Oral steroids are usually given in short courses of a few days to control severe asthma attacks.

Statistical Analysis

Using the MEPS sample, we estimated multivariate regression models with four measures of asthma care as dependent variables: (1) number of office-based provider visits for asthma; (2) number of prescriptions filled for reliever medications; (3) number of prescriptions filled for controller medications; and (4) number of prescriptions filled for oral steroids. Since these variables assume small, non-negative integer values, we used negative binomial regression to model them.[32] Because a child's first diagnosis of asthma can occur during the MEPS data collection period, we calculated the relevant number of days of observation with asthma for each asthmatic child and used this number as an offset term in the negative binomial models.*

Using the NSCH sample, we estimated multivariate regression models with two measures of the severity of each child's asthma symptoms as dependent variables: (1) the severity of health difficulties caused by asthma, derived from the survey question "would you (the parent) describe the health difficulties caused by [his/her] asthma as mild, moderate, or severe?", and (2) whether the child had an asthma attack during the past 12 months, derived from the question "during the past 12 months, has [he/she] had an episode of asthma or an asthma attack?" We used ordinal logistic regression to model health difficulties caused by

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* We assessed whether a zero-inflated negative binomial model was more appropriate for our data than the non-flated version using the Vuong statistic[41], which has as its null hypothesis the equivalence of the two models. Only for controller medications was there any suggestion that the zero-inflated model might be superior (two-sided p=0.14; one-sided p=0.07). However, adjusted predictions of the number of prescriptions for controller medications by family structure were nearly identical using both models. Therefore, in the paper we report results for the non-inflated models.

asthma and binary logistic regression to model whether the child had an asthma attack.[33] We conducted analyses on the full sample of 11,177 children in the NSCH who had been told by a health professional they had asthma and, separately, on the subsample of 7,956 children who reported their asthma was active.

The key explanatory variables in both the MEPS and NSCH analyses were the family structure variables: (1) an indicator variable for living in a single-mother family (versus a two-parent family); and (2) indicator variables for the number of other children in the household, categorized as zero, one, two, or three or more.

Other explanatory variables in the MEPS models included indicator variables for the child's age; sex; race or ethnicity, categorized as non-Hispanic white, non-Hispanic black, Hispanic, or other; family income, categorized as poor (<1.00 times the federal poverty line), low-income (1.00-1.99 times poverty), middle-income (2.0-3.99 times poverty), or high-income (4.00+ times poverty); insurance coverage, categorized as uninsured, private insurance, or public insurance; and residence in a metropolitan area. We also included indicator variables for the child's birth order, categorized as first, second, or third or higher; whether the child had an older sibling with asthma; the mother's education, categorized as no high school, some high school, high school graduate, or some college or higher; the mother's age, categorized as 25 years or younger, 26-35 years, 36 years or older; and the year of the data. We included birth order and whether an older sibling had asthma to capture differences in parents' experience with child-rearing and taking care of children with asthma. We included maternal education and age to capture differences in mothers' knowledge about health and health care as well as additional dimensions of their judgment and life experience.

Since MEPS did not contain direct measures of asthma severity, and since the intrinsic severity of asthma affects the need for and use of care, we also included as explanatory variables in the MEPS models several health status variables that are likely to be correlated with asthma severity. These variables included the child's self-rated (or parent-rated) general health, categorized as excellent, very good, good, fair, or poor; the parent's report that the child was "not being as healthy as other children;" the parent's report of any health limitation for the child; and the child having sinusitis, otitis media, or upper respiratory infections during the data collection period.

Other explanatory variables in the NSCH models mirrored those in the MEPS models, with a few exceptions. Thus the explanatory variables in the NSCH models included indicators for the child's age, sex, race or ethnicity, family income, insurance coverage, residence in a metropolitan area, and birth order. However, NSCH did not report maternal education, but rather the highest level of education obtained by anyone in the household, which we categorized as no high school degree, high school graduate, and some college or higher. Additionally, NSCH did not include information on maternal age or whether the child had an older sibling with asthma. Finally, because the dependent variables in the NSCH models were asthma outcomes, we did not include measures of health status as explanatory variables in the NSCH models.

To facilitate interpretation of the regression results, we used the coefficient estimates from the negative binomial and logistic regression models to obtain the predicted mean number of visits and prescriptions and the predicted distribution of severity of asthma symptoms for each value of each family structure variable (e.g., each value of number of parents), adjusted for all the other explanatory variables. Thus, for the MEPS sample, we

used the estimated coefficients from the negative binomial models to predict the number of visits and prescriptions for each child, alternately assigning the child to each category of the family structure variable of interest (e.g., single-mother vs. two-parent family), but leaving all other explanatory variables at their original values including the offset term. Next, we annualized the individual predictions by multiplying by 365 and dividing by the number of days used as the offset. Last, we averaged the annualized predictions across all the children in the MEPS sample. This procedure yields what the mean annual number of visits and prescriptions would be if all children in the sample lived in each particular type of family (e.g., single-mother or two-parent family), but otherwise retained the original values of all their other characteristics. Similarly, for the NSCH sample, we predicted the probabilities of no, mild, moderate, and severe health difficulties from asthma and of having an asthma attack during the past 12 months for each child, alternately assigning the child to each category of the family structure variable of interest, but leaving all other explanatory variables at their original values. We then averaged the individual predicted probabilities across all the children in the NSCH sample.

We weighted all analyses using weights that reflect the sample design of the MEPS and the NSCH as well as survey non-response, and we adjusted all standard errors for clustering using the Huber-White sandwich estimator.[34-36]

RESULTS

Descriptive Data

Table 1 shows that the characteristics of the MEPS and NSCH samples were similar in most respects, reflecting the fact that both surveys are nationally representative. About 30 % of asthmatic children lived with a single mother and just under one-fourth lived with no other

children, nearly two-fifths lived with one other child, and about one-fourth lived with two

other children. One-fifth of asthmatic children were black, about 15% were Hispanic, and

one-fifth were poor. Only 6 % of asthmatic children were uninsured, and most had private

health insurance. The major difference between the MEPS and NSCH samples was in

residential location: More than four-fifths of asthmatic children in the MEPS sample lived in

metropolitan areas, compared with less than three-fourths in the NSCH sample.

Approximately 56 % of asthmatic children were first born and 30 % were second born; 12%

of the children in the MEPS sample had an older sibling with asthma.

The children in the MEPS sample averaged two office-based visits for asthma during

their period of observation with asthma (mean, 528 days), and 56% had at least one such visit

(Table 2). Three-fifths of the children filled at least one prescription for a reliever medication,

compared with about 30% who filled at least one controller-medication prescription.

However, the children who filled at least one controller-medication prescription averaged

more than five such prescriptions, suggesting that many of them used these medications

continuously. Nearly 30% of the children in the NSCH sample reported that their asthma was

inactive, and just under half reported mild health difficulties from asthma. About 46% of the

sample had an asthma attack during the preceding 12 months.

Multivariate Analyses

We found a significant effect of family structure on the care children received for

asthma, adjusting for all the other explanatory variables in the regression models (Table 3).

Thus, compared with children living in two-parent families, asthmatic children with a single

mother had fewer office-based visits annually for asthma (1.38 vs. 1.74, P<.10), filled fewer

prescriptions for reliever medications (1.45 vs. 1.71, P<.10), and filled substantially fewer

prescriptions for controller medications (0.86 vs. 1.39, P<.01). Additionally, compared with

children who lived with no other children, asthmatic children who lived with two or more

other children had fewer visits for asthma and filled fewer prescriptions each year for asthma

medications. Specifically, children living with no other children had 1.91 visits annually,

whereas children living with two other children had 1.32 visits (P<.05) and children living

with three or more other children had 1.06 visits (P<.01). Children living with no other

children filled 1.90 prescriptions annually for reliever medications, whereas children living

with two other children filled 1.45 prescriptions (P<.05) and children living with three or

more other children filled 1.20 prescriptions (P<.01). Children living with no other children

filled 1.55 prescriptions annually for controller medications, whereas children living with

three or more other children only filled 0.92 prescriptions (P<.05). Finally, children living

with no other children filled 0.31 prescriptions each year for oral steroids, whereas children

living with three or more other children filled 0.16 prescriptions (P<.10). (Of note, the

adjusted means shown in Table 3 are not comparable to the unadjusted means in Table 2

because the former are annualized and the latter are not.)

We also found that family structure was associated with asthma outcomes, although

these results were weaker and less consistent than those for asthma care. In analyses using the

full NSCH sample, children in single-mother families were more likely than children with two

parents to have moderate or severe health difficulties caused by their asthma (P<.10) (Fig. 1,

Panel A). However, the number of other children in the household was unassociated with the

severity of health difficulties from asthma. Further, family structure was unassociated with

health difficulties from asthma in analyses using the sub-sample of children with active asthma (Fig. 1, Panel B).

In analyses using the sub-sample of children with active asthma, those who lived with two other children were more likely than those living with no other children to have an asthma attack during the preceding 12 months (P<.05) (Fig. 2, Panel B). Based on a similar point estimate for children living with three or more other children, we conducted a *post hoc* analysis in which we created a combined category for children with active asthma who lived with two or more other children. We found that these children were more likely than children living with no other children to have an asthma attack in the past 12 months (P<.05). We found no other significant associations between family structure and the probability of having an asthma attack.

Findings for other explanatory variables in the MEPS models were generally consistent with expectations based on prior studies (see Appendix I).[18-21] For example, race and ethnicity had independent effects on asthma care, with black and Hispanic children filling more prescriptions for reliever medications than white children. Children of more highly educated mothers had more office-based visits and filled more prescriptions for controller medications than children of mothers with less education. Insured children had more office-based visits than their uninsured counterparts, and publicly insured children filled more prescriptions of all types than uninsured children.

Several findings for other explanatory variables in the NSCH models were also noteworthy (see Appendix II). Black and Hispanic children reported more severe health difficulties from asthma than white children; however, Hispanic children had a lower probability than white children of having an attack during the past 12 months. Non-poor

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children had less severe health difficulties from asthma than poor children, and children with private insurance had less severe health difficulties than uninsured children.

DISCUSSION

This study is the first to link family structure to the care children with asthma receive and to their asthma outcomes. We found that children who lived with a single mother and children who lived with two or more other children had fewer office-based visits for asthma and used less asthma medication than children in two-parent families and children who lived with no other children, respectively. We also found weaker evidence that children who lived with a single mother and children who lived with two or more other children experienced more severe asthma symptoms than their peers. The most straightforward interpretation of these findings is that asthmatic children who live with a single mother or with two or more other children receive less adequate asthma care than their peers, and that the less adequate care results in worse control of their disease.

In support of this interpretation, the effects of family structure on asthma visits and prescription medications are likely to be large enough to have clinical consequences. For instance, children in single-mother families filled 38% fewer prescriptions for controller medications than children in two-parent families, and children living with three or more other children filled 41% fewer prescriptions that children living with no other children (Table 3). These represent sizable reductions in the use of medications that are vital for the control of asthma symptoms and prevention of exacerbations. Similarly, the differences in asthma visits across families of different types represent very different intensities of monitoring and follow-up. For example, the predicted mean numbers of asthma visits correspond to a visit every 6.3

months for an average child living with no other children and a visit every 11.3 months for an average child living with three or more other children.

The mechanisms through which family structure affects the asthma care children receive are likely to be rooted in differences across types of families in the time and attention parents can devote to monitoring and managing their children's health. Numerous studies have found that family structure influences children's cognitive, educational, and behavioral outcomes.[1-10] As noted earlier, children in single-parent households have worse educational outcomes than children from two-parent households.[1] Similarly, Blake has argued that the higher the number of children, the more parental resources are divided, even taking into account economies of scale.[2-3] Studies demonstrating an inverse relationship between number of siblings and children's intellectual development and educational achievement are consistent with this framework.[4-5, 7-10, 37]

Our findings suggest that the asthma care children receive may be susceptible to the dilution of parental resources as well. In single-mother families and in families with many children, parents may not have the time, energy, or financial resources to monitor each child's symptoms and/or take the child for care as needed. This view is consistent with earlier studies on family structure and children's office visits and immunization status.[13-15, 16, 38-39]

The most salient threat to the validity of our inferences regarding the effects of family structure on the adequacy of asthma care is an unrecognized association between family structure and the intrinsic severity of childhood asthma. Thus, if children who live with a single mother or with several other children intrinsically have less severe asthma than their counterparts who live with two parents or with no other children, our findings regarding family structure and asthma care could reflect appropriate patterns of care. We could not

definitively rule out such an unrecognized association because the MEPS data did not include direct measures of asthma severity. Nonetheless, an unrecognized association is unlikely to be a factor in our study for three reasons. First, our multivariate analyses of MEPS data controlled for a wide array of variables that are correlated with asthma severity including sociodemographic characteristics and several measures of health status. These indirect measures of asthma severity likely provide considerable protection against bias from an unrecognized association. Second, the unrecognized association of concern would be expected to be reflected in the NSCH analyses, and specifically, in finding that children in single-mother families and children living with several other children had less severe asthma symptoms than their peers. In fact, we found evidence for the opposite pattern. Third, we know of no clinical reason why family structure should be associated with the intrinsic severity of asthma after controlling for sociodemographic factors.

Our study has several additional limitations. First, as in any observational study, our findings may be subject to omitted variable bias from unobserved parental or family characteristics. In particular, studies suggest that single mothers may differ from married mothers in their attitudes about family, work, and parenting, and that these differences in attitudes may influence a child's home and family environment as well as parent-child relationships[1, 40]. Possibly these differences in attitudes also influence the health care parents seek for their children. We know of no evidence to suggest that parents' choices regarding number of children are related to their attitudes about family or parenting.

Second, we did not study single-father families; thus our findings cannot be generalized to these families. Third, we used two complimentary data sources to assess the effect of family structure on asthma care and asthma symptoms, but our analyses did not

establish a direct link between decreased use of visits and medications and worse symptom control. Fourth, we were unable to account for differences across Hispanic subgroups in asthma severity. Last, we analyzed filled prescriptions because we had no information on medication adherence. In a related vein, we had no information on whether children received free medications from their providers or whether they shared medications, especially inhalers, with asthmatic siblings.

Despite these limitations, our study sheds important new light on the role of families in children's asthma care and outcomes. Our findings suggest that children can be vulnerable to inadequate asthma care as a result of the makeup of their families, and that health care providers who treat children must plan and monitor their care in the context of their family circumstances.[11] In particular, providers should monitor especially closely the care received by and clinical status of as asthmatic children who live with single mothers or with several siblings. Our findings also imply that policies that provide support for working single mothers or parents with many children, such as family leave days, may enable parents to take their children for health care while alleviating stress and other demands on their time.

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Table 1. Characteristics of the MEPS and NSCH Study Samples.

Variable		MEPS N*	MEPS Percent†	NSCH N*	NSCH Percent†
Family Structure					
Number of parents	Two parents	1,684	69.7 %	7,749	69.8 %
	Single mother	973	30.3 %	3,060	30.2 %
Number of other children	None	549	23.2 %	4,690	23.2 %
	1	979	38.5 %	4,190	39.6 %
	2	668	22.9 %	1,686	25.0 %
	3 +	461	15.4 %	611	12.2 %
Other Explanatory Variables					
Age	2-5	662	24.9 %	1,968	19.3 %
	6-9	663	24.8 %	2,435	24.8 %
	10-13	722	26.2 %	3,069	27.6 %
	14-17	610	24.1 %	3,705	28.3 %
Sex	Female	1,079	40.6 %	4,648	40.5 %
	Male	1,578	59.4 %	6,522	59.5 %
Race/ethnicity	White	1,159	59.5 %	7,138	56.8 %
	Black	624	20.4 %	1,548	20.2 %
	Hispanic	771	16.3 %	1,312	14.6 %
	Other	103	3.8 %	1,009	8.3 %
Family income	Poor	732	20.5 %	1,504	19.5 %
	Low Income	696	21.4 %	2,115	23.5 %

	Middle Income	749	32.6 %	3,574	32.4 %
	High Income	480	25.5 %	3,040	24.6 %
Health insurance	Uninsured	175	5.8 %	629	6.0 %
	Public	1,009	27.9 %	3,022	32.0 %
	Private	1,473	66.3 %	7,511	62.0 %
Metropolitan residence	Yes	2,168	82.1 %	5,682	72.9 %
	No	489	17.9 %	5,495	27.1 %
Maternal education§	No high school	213	5.0 %	---	-----
	Some HS	481	14.6 %	444	6.6%
	HS degree	914	35.0 %	2,501	27.4 %
	≥ Some college	1,038	45.4 %	8,199	66.0 %
Maternal age	25 or younger	225	6.7 %	---	-----
	26-35	991	36.4 %	---	-----
	36 or older	1441	56.9 %	---	-----
Birth order	First born	1,397	55.8 %	7,723	56.0 %
	Second born	837	30.2 %	2,694	30.3 %
	≥ Third born	423	14.0 %	760	13.7 %
An older sibling with asthma	Yes	343	11.7 %	---	-----
	No	2,314	88.3 %	---	-----
Health Status	Excellent	675	26.7 %	---	-----
	Very good	806	31.3 %	---	-----
	Good	821	31.7 %	---	-----

	Fair	280	9.0 %	---	-----
	Poor	49	1.3 %	---	-----
"Not as healthy as other children"	Yes	1,278	51.0 %	---	-----
	No	1,372	49.0 %	---	-----
Any Limitation	Yes	262	10.4 %	---	-----
	No	2,364	89.6 %	---	-----
Sinusitis	Yes	188	8.8 %	---	-----
	No	2,469	91.2 %	---	-----
Otitis Media	Yes	498	20.4 %	---	-----
	No	2,159	79.6 %	---	-----
URI	Yes	896	33.9 %	---	-----
	No	1,761	66.1 %	---	-----

* Unweighted sample size.

† Weighted percentage.

§ The MEPS variable was based on the child's mother's education. The NSCH variable was based on the highest level of education obtained by anyone in the household.

Table 2. Descriptive Statistics for Study Outcomes, MEPS and NSCH.

Variables	Weighted Value
Office-based visits for asthma*	
Mean number of visits	2.01
Percent with any visit	56.2 %
Mean number for those with > 0 visit	3.58
Reliever medication prescriptions*	
Mean number of prescriptions	2.20
Percent with any prescription	60.8 %
Mean number for those with > 0 prescription	3.61
Controller medication prescriptions*	
Mean number of prescriptions	1.61
Percent with any prescription	29.8 %
Mean number for those with > 0 prescription	5.41
Oral steroid prescriptions*	
Mean number of prescriptions	0.31
Percent with any prescription	14.1 %
Mean number for those with > 0 prescription	2.18
Health difficulties caused by asthma†	
Inactive	28.9 %
Mild	46.1 %
Moderate	21.2 %
Severe	3.8 %

Asthma episode or attack during past 12 month†

      Yes   46.4 %

      No   53.6 %

* From MEPS. The mean period of observation with asthma was 528 days.

† From NSCH.

Table 3. MEPS: Predicted Annual Number of Asthma Visits and Filled Prescriptions, by Family Structure, Adjusted for Other Explanatory Variables.†

Family Structure Variables	Office Visits for Asthma	Prescriptions for Reliever Medications	Prescriptions for Controller Medications	Prescriptions for Oral Steroids
Number of parents				
Two parents§	1.74	1.71	1.39	0.27
Single mother	1.38*	1.45*	0.86***	0.19
Number of other children				
None§	1.91	1.90	1.55	0.31
1 other	1.87	1.75	1.21	0.24
2 other	1.32**	1.45**	1.09	0.24
3 or more other	1.06***	1.20***	0.92**	0.16*

†Predicted values are adjusted for the child's age, sex, race or ethnicity, family income, health insurance, metropolitan residence, and birth order; having an older sibling with asthma; the mother's education and age; and measures of the child's health status. Predicted values for each family structure variable (e.g., number of parents) are also adjusted for the other family structure variable.

§ Comparison category for the variable.

* $P < 0.10$ for test of difference with the comparison category.

** $P < 0.05$ for test of difference with the comparison category.

*** $P < 0.01$ for test of difference with the comparison category.

Figure 1. NSCH: Predicted Percent of Children With No, Mild, Moderate, and Severe Health Difficulties From Asthma, by Family Structure, Adjusted For Other Explanatory Variables.†
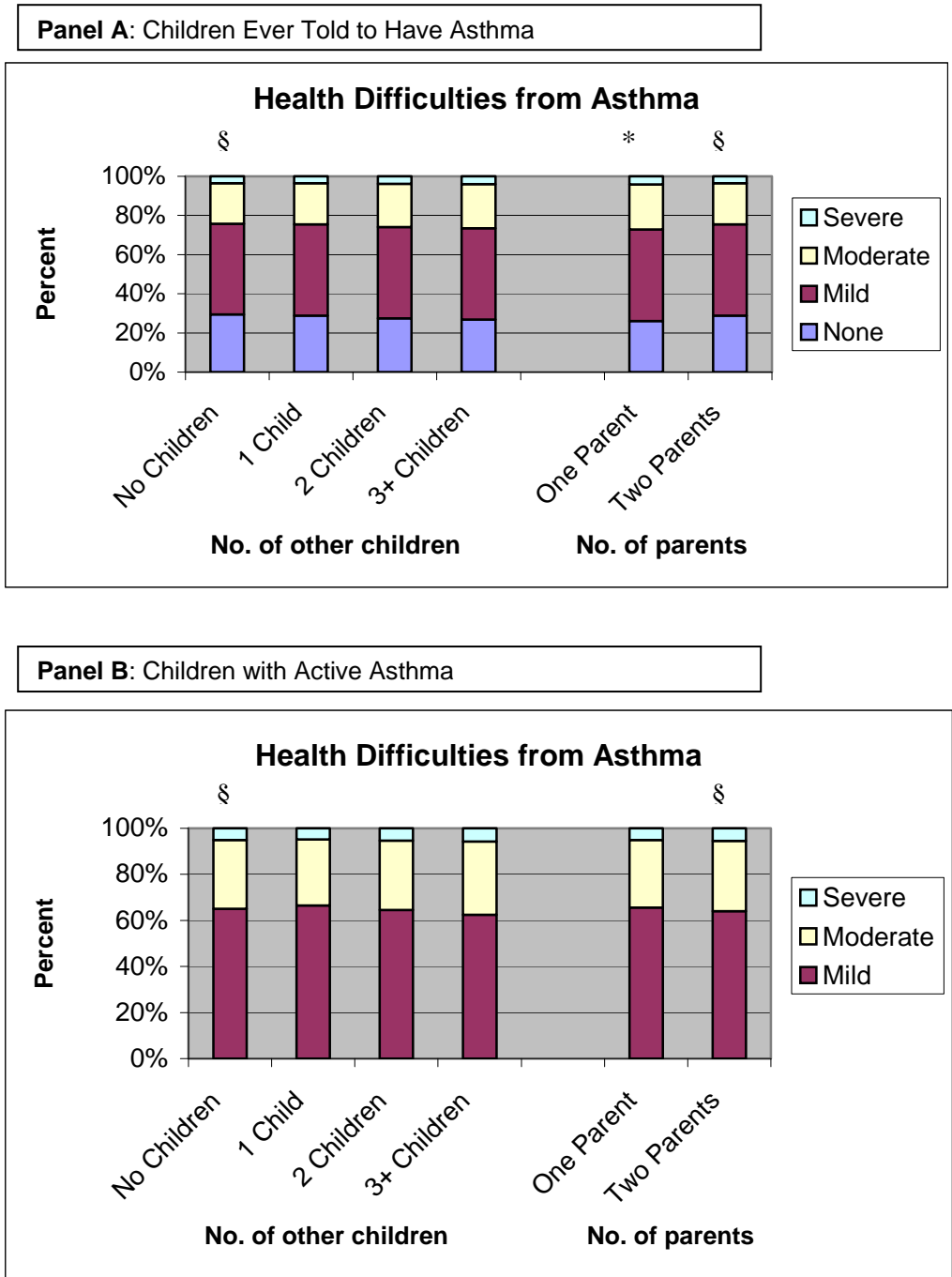
Panel A: Children Ever Told to Have Asthma

Panel B: Children with Active Asthma

† **Panel A is for the sample of children ever told to have asthma, and Panel B is for children who report active asthma during the survey year. Each stacked column displays the predicted distribution of severity of health difficulties from asthma for a particular value of the family structure variable of interest. For example, the column farthest to the left in Panel A shows that, if all children ever told to have asthma lived with no other children, 29 percent would have no health difficulties from asthma, 46 percent would have mild difficulties, 21 percent would have moderate difficulties, and 4 percent would have severe difficulties.** Predicted percents are adjusted for all the other explanatory variables in the model (see text). Predicted percents for each family structure variable (e.g., number of parents) are also adjusted for the other family structure variable.

§Comparison category for the variable.

* P < 0.10 for test of difference with the comparison category.

** P < 0.05 for test of difference with the comparison category.

Figure 2. NSCH: **Predicted Percent of Children Reporting An Asthma Attack In the Past 12 Months, by Family Structure, Adjusted For Other Explanatory Variables.†**

Panel A: Children Ever Told to Have Asthma

Asthma Attack during Past 12 Months

Panel B: Children with Active Asthma
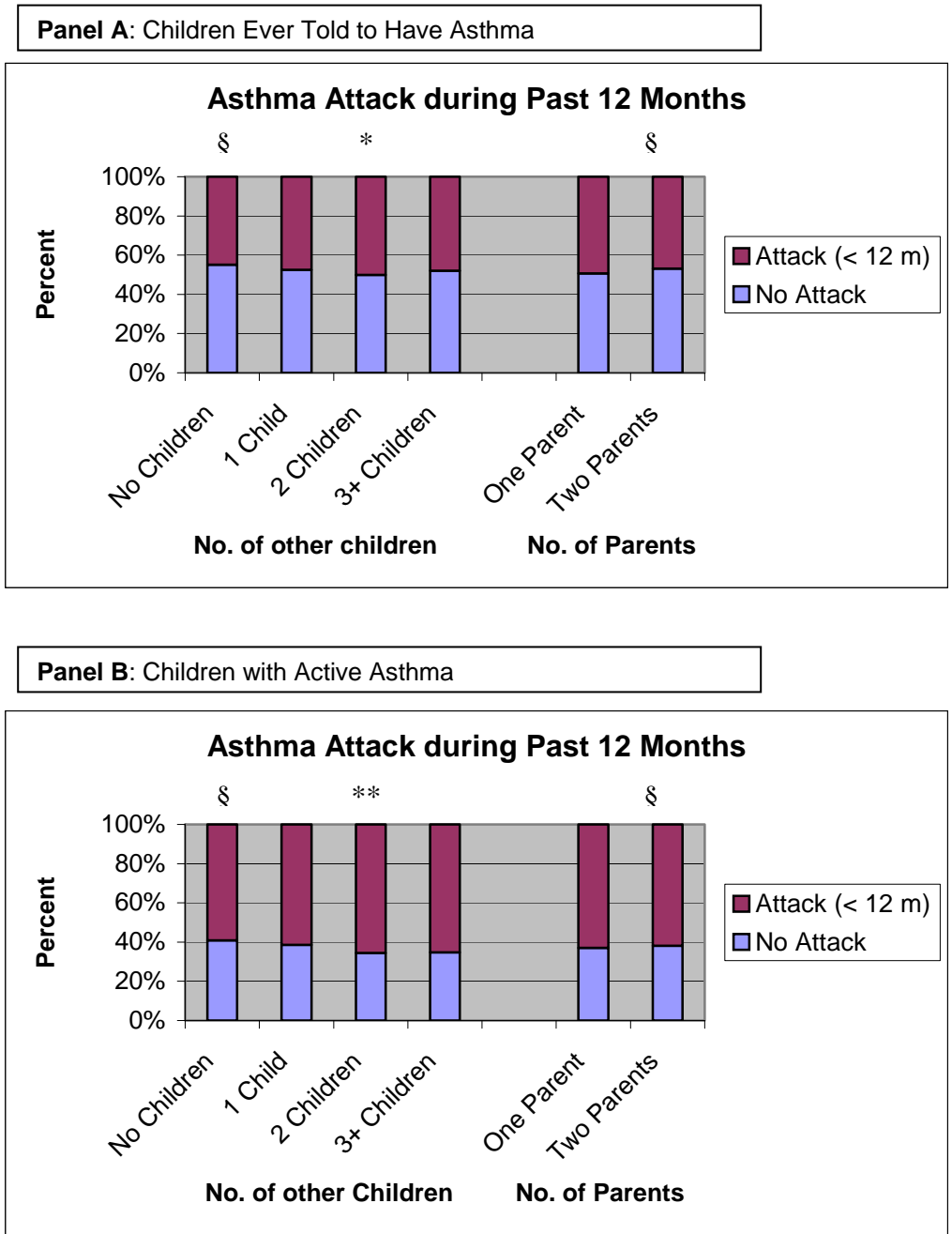
Asthma Attack during Past 12 Months

† Panel A is for the sample of children ever told to have asthma, and Panel B is for children who report active asthma during the survey year. Each stacked column displays the predicted percent of children who report having an asthma attack in the

past year for a particular value of the family structure variable of interest. For example, the column farthest to the left in Panel A shows that, if all children ever told to have asthma lived with no other children, 55 percent would have an asthma attack during the past 12 months. Predicted values are adjusted for all the other explanatory variables in the model (see text). Predicted values for each family structure variable (e.g., number of parents) are also adjusted for the other family structure variable.

§Comparison category for the variable.

* P < 0.10 for test of difference with the comparison category.

** P < 0.05 for test of difference with the comparison category.

Appendix I. MEPS: Regression Coefficients for All Covariates, From Negative Binomial

Regression Models.

Variable	Office Visits for Asthma	Prescriptions for Reliever Medications	Prescriptions for Controller Medications	Prescriptions for Oral Steroids
Age				
2-5 years§	-----	-----	-----	-----
6-9 years	-0.22	-0.03	0.20	-0.63**
10-13 years	0.40**	0.01	0.25	-0.95***
14-17 years	-1.08***	-0.12	-0.10	-1.36***
Gender				
Male§	-----	-----	-----	-----
Female	0.09	0.11	0.04	-0.21
Race/ethnicity				
White§	-----	-----	-----	-----
Black	0.14	0.40***	-0.02	0.22
Hispanic	0.42***	0.31***	0.04	0.18
Other	0.37	-0.08	-0.22	-0.14
Family income				
Poor§	-----	-----	-----	-----
Low income	0.09	-0.09	0.21	0.31
Middle income	-0.27*	-0.07	-0.03	-0.08
High income	-0.25	-0.20	-0.03	-0.10
Insurance				
Uninsured§	-----	-----	-----	-----
Public	0.35*	0.53***	0.44*	1.05***

Private	0.34*	0.18	0.12	1.13***
MSA				
No§	-----	-----	-----	-----
Yes	-0.17	0.17	-0.24	0.67***
Maternal education				
< High school§	-----	-----	-----	-----
Some HS	0.05	0.14	-0.61**	-0.17
HS degree	0.27	0.29*	0.27	-0.07
≥ College	0.72***	0.49***	0.55**	-0.07
Maternal age				
≤ 25 years§	-----	-----	-----	-----
26-35 years	0.28	0.21	-0.30	0.07
≥ 36 years	0.63**	0.29	-0.26	0.23
Birth order				
First born§	-----	-----	-----	-----
Second born	-0.24*	0.11	0.17	0.08
≥ Third born	-0.01	0.22	-0.07	-0.10
An older sibling with asthma				
No§	-----	-----	-----	-----
Yes	-0.16	-0.33***	-0.21	-0.31
Health Status				
Poor§	-----	-----	-----	-----
Fair	-0.47*	-0.12	-0.18	-1.66***
Good	-0.97***	-0.52	-0.69	-1.92***
Very good	-1.20***	-0.73*	-1.01**	-2.16***

Excellent	-1.30***	-0.78*	-1.30***	-2.58***
"Not as healthy as other children"				
No§	-----	-----	-----	-----
Yes	0.18	0.06	0.11	0.40**
Any limitation				
No§	-----	-----	-----	-----
Yes	-0.22	0.29*	0.15	0.06
Reported Conditions Sinusitis				
No§	-----	-----	-----	-----
Yes	0.14	0.23*	0.44**	-0.19
Otis Media				
No§	-----	-----	-----	-----
Yes	0.01	0.04	0.05	-0.16*
Upper Respiratory Infection No§	-----	-----	-----	-----
Yes	-0.07**	-0.03	-0.03	-0.03
Number of parents				
Two parents§	-----	-----	-----	-----
Single mother	-0.23*	-0.17*	-0.48***	-0.34
Number of other children				
None§	-----	-----	-----	-----
1 other	-0.02	-0.09	-0.25	-0.27
2 other	-0.37**	-0.27**	-0.35	-0.26
3 or more other	-0.59***	-0.46***	-0.53**	-0.69*

§Comparison category for the variable.

* $P \leq 0.10$ for test of difference with the comparison category.

** $P \leq 0.05$ for test of difference with the comparison category.

*** $P \leq 0.01$ for test of difference with the comparison category.

Appendix II. NSCH: Odds Ratios for All Covariates, From Ordinal Logistic and Binary Logistic Regression Models.

Variables	All Children with Asthma		Children with Active Asthma	
	Health Difficulties from Asthma	Asthma Attack < 12 month	Health Difficulties from Asthma	Asthma Attack < 12 month
Age				
2-5 years§	-----	-----	-----	-----
6-9 years	0.83*	0.73***	0.98	0.85
10-13 years	0.81**	0.79**	0.79*	0.87
14-17 years	0.66***	0.56***	0.73**	0.68***
Gender				
Male§	-----	-----	-----	-----
Female	1.13*	1.11	0.90	0.98
Race/ethnicity				
White§	-----	-----	-----	-----
Black	1.24**	0.93	1.27*	0.82
Hispanic	1.05	0.69***	1.91***	0.74**
Other	1.01	0.89	0.98	0.84
Family income				
Poor§	-----	-----	-----	-----
Low income	0.55***	0.91	0.55***	1.09
Middle income	0.52***	0.88	0.43***	1.05
High income	0.45***	0.92	0.35***	1.22
Insurance				
Uninsured§	-----	-----	-----	-----

Public	1.03	1.09	0.73	0.97
Private	0.82	0.93	0.55***	0.81
MSA				
No§	-----	-----	-----	-----
Yes	1.00	1.06	1.10	1.09
Maternal education				
< High school§	-----	-----	-----	-----
HS degree	0.80	1.27	0.93	1.53*
Post High School	0.82	1.74**	0.76	2.25***
Birth order				
First born§	-----	-----	-----	-----
Second born	1.03	1.07	1.00	1.09
≥ Third born	1.03	1.47**	0.98	1.58**
Number of parents				
Two parents§	-----	-----	-----	-----
Single mother	1.15*	1.11	0.92	1.05
Number of other children				
None§	-----	-----	-----	-----
1 other	1.03	1.11	0.93	1.11
2 other	1.10	1.24*	1.02	1.33**
3 or more other	1.15	1.13	1.12	1.30

§Comparison category for the variable.

* P ≤ 0.10 for test of difference with the comparison category.

** P ≤ 0.05 for test of difference with the comparison category.

*** P $\leq$ 0.01 for test of difference with the comparison category.