Examining the association between childhood asthma and parent and grandparent asthma status: Implications for Practice

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Abstract

Examination of intergenerational asthma beyond maternal asthma has been limited. The
association between childhood asthma and intergenerational asthma status among a national
cohort of children was examined.

The genealogical sample (2,552 children) participating in the Child Development Supplement of
the Panel Study of Income Dynamics. Multivariate regression was used to determine
intergenerational asthma.

Children with a parent with asthma were almost twice as likely (OR=1.96) to have asthma
compared to those without a parent with asthma. Children with a parent and grandparent with
asthma were over four times more likely to have asthma compared to those without a parent and
grandparent with asthma (OR=4.27). Children with a grandparent with asthma were more likely to
have asthma (OR=1.52).

A family history of asthma was a significant predictor of physician diagnosed asthma in children
regardless of race/ethnicity and socioeconomic status. Findings support the collection of family
history, including grandparent asthma status.

Keywords

asthma; intergenerational; panel study

Introduction

Asthma continues to be a prevalent chronic disease for both children and adults in the United States impacting individuals across the lifespan. Disparities in asthma prevalence are widely recognized with African Americans, Puerto Ricans, and male children having disproportionate rates[1-2] and females more likely to have asthma in adulthood. [3-5] The high cost of asthma health care is driven by the ambulatory care use estimated at 13.6 million office care visits and over 1.5 million emergency department visits each year.[3, 6-8]

Several risk factors for asthma have been identified including, skin test reactivity to allergens, atopic dermatitis, human leukocyte antigen genes, and family history.[9-12] An area of asthma research that continues to be investigated is the association between family history and childhood asthma.[13-18] More recently studies have focused on the examination of family history of asthma as an explanatory variable for the disproportionate rates of asthma in underserved minorities. This line of inquiry has been driven by research findings suggesting that ethnicity remains a risk factor for asthma regardless of socioeconomic status (SES).[27-29]

Research to identify family risk has focused on parental influence, specifically birth order, genetic predisposition, and maternal asthma.[13-14, 25-30] Study results examining asthma family risk have been inconclusive with some pointing to a maternal link and others a paternal link, while others have not found an association between asthma and family history. [27-29] The impact of birth order has also shown mixed findings on asthma risk with higher birth order as a risk factor, lower birth order as a risk, and no relationship to birth order.[24-26] Examinations of the bilateral genetic (maternal and paternal asthma) risk of asthma indicates that asthma risk is not only driven by genetic factors, but perhaps by psychosocial and environmental factors contributing to asthma onset or changes in treatment of respiratory and gastroenteric infections.[29-31]

The aim of the current study is to examine intergenerational asthma in a cohort of children. To our knowledge this study is the first national analysis of childhood asthma associated with parental and grandparental asthma among a large nationally representative cohort sample of Caucasian and African American children.

Materials & Methods

Data for this study were obtained from the Panel Study of Income Dynamics (PSID), a 35-wave panel survey of a nationally representative sample of approximately 8,000 U.S. families, and the Child Development Supplement (CDS), a nationally representative longitudinal study of over 2,900 children within PSID families. Since 1968, the PSID has collected data on family composition changes, health, housing and food expenditures, marriage and fertility, employment, income, and other household related variables. The PSID has a genealogical sample design whereby descendants of sample members are interviewed when they begin to live independently. As a result, multiple generations within the same family are interviewed, providing data on children, their parents, and their grandparents. The CDS gathers data on socio-demographic, psychological and economic aspects of childhood. By merging data from the CDS with the PSID we were able to take advantage of an extensive amount of family demographic and health data reported by parents and grandparents of CDS children. All study protocols have been approved by the University of Michigan Institutional Review Board. Informed consent was completed prior to the collection of survey data.

Study Sample

In 1997, as interviews were completed with PSID families, family units with children under age 13 were identified for inclusion in the CDS-I. Of the 2,705 families selected for the CDS-I, 2,394 (88.5%) families participated, providing information on 3,563 children. In families with more than two children, two of the children were randomly selected for inclusion and interviewed. CDS-II was conducted in 2002 and followed the CDS-I sample children whose families were still active in the 2001 PSID main study. CDS-II data collection resulted in completed interviews for 2,907 children.

Since we were interested in the differences in asthma rates for Caucasian and African American children, our study sample includes data for the 2,552 Caucasian and African American children, representing 88% of the CDS-II sample. Children ranged in age from 5-19 years. For 2,481 (97.2%) children at least one biological parent's asthma status was known, and for 1,784 (70%) children both the asthma status of at least one biological parent and at least one biological grandparent were known.

Study Measures

Asthma—Childhood asthma status was determined in the CDS by a positive response from the child's caregiver to the question, "Has (child's) doctor or health professional ever said that ("Name of Child") has asthma?" The PSID collected asthma status from adults beginning in 1986. Parental asthma was determined by a positive response to the question "Has a doctor or health professional ever told you that you have asthma?" in any of the PSID waves. This self-reported measure of physician diagnosis has been used since 2000 by the Behavioral Risk Factor Surveillance System (BRFSS) state-based telephone survey and is a valid and reliable self-reported measure of lifetime asthma in both children and adults. In the PSID, asthma status is known for 97.5 % of biological mothers, 79% of biological fathers, and 77% of biological grandparents. The rate of missing data, particularly for grandparents, is primarily due to the fact that some grandparents and parents have not been interviewed in the years that adult asthma data were collected.

Parental and grandparent asthma is categorized into one of three groups: 1) parental and grandparental asthma status is known and they have asthma, 2) parental and grandparental asthma is known and they do not have asthma, and 3) parental and grandparental asthma is unknown (because they were not interviewed in the year the asthma data were collected). When asthma status of both parents is known, the mother's asthma status is used to define parental asthma status. When more than one grandparental asthma status is known, we use the status of the grandparent who ranks highest in the following order: maternal grandmother, maternal grandfather, paternal grandmother, and paternal grandfather. Sensitivity analyses completed indicated that the correlation between child and parental and grandparental asthma were robust to different selection of parent and grandparent.

Socioeconomic Status—The PSID variables describing the socioeconomic status of families of CDS children include biological parent's educational level, employment status, total family income, and wealth. The PSID collects data related to eight broad wealth categories, including: equity in real estate, vehicles, transaction accounts (e.g., savings accounts, money market funds, and certificates of deposit), other assets (e.g., cash value in a life insurance policy, and rights in a trust or estate), equity in Individual Retirement Accounts, and the value of debt aside from mortgage or vehicle loans. These eight categories for data collected in 2001 are combined and used as an indicator of wealth for the sample.

Smoking—Parental smoking status was collected as a self-reported measure in the PSID. Smoking status is classified into 4 groups: current smoker, past smoker, never smoked, and missing information on smoking status. Current parental smoking is based on a positive response to "Are you currently smoking?", a past smoker is someone who answered positively to "Have you ever smoked" in a previous study wave (2001 wave), but indicated in the most recent wave that they were not currently smoking (2003 wave).

Asthma medications and allergies—Caregivers of children with asthma were asked whether the child was taking asthma medications (yes/no). The caregiver participants were asked whether the child's doctor or a health professional ever said that child had allergies (yes/no). No specific type of allergy was identified.

Other measures—Other childhood variables selected from the CDS included the number of children in the household, birth order of the child, child's living arrangements with biological mother and father, birth weight, and neonatal intensive care exposure. All study measures are based on self-reports by the child's caregiver.

Statistical analysis

Analyses were performed using the SAS statistical package. All analyses were conducted on the total sample and separately for each ethnic group. To account for differential probabilities of selection due to the original PSID sample design and subsequent attrition, all analyses were conducted using CDS sample weights.[32] Multivariate logistic regression (GENMOD) adjusting for repeated measures for the family was used to determine the risk of childhood asthma, after adjusting for covariates associated with asthma including age, sex, race, family history of asthma, birth order, biological parent's education, and smoking status. The family unit was used as the clustering variable to account for households with two children (N=472). For all variables with missing values an indicator variable for missing status was included in the models; that is, instead of dropping cases with missing data on a particular variable, we create a new variable that takes the value one if the observation has missing data on the particular variable of interest, and zero otherwise. These indicator variables are then included as explanatory variables in the multivariate models Statistical significance was based on a *P* value of less than 0.05.

Results

Sample description

The characteristics of the sample are presented in Table 1. Of the weighted PSID/CDS sample (N=2552) 51% was male and 80% was Caucasian (20% African American). The age of the children ranged from 5 to 19, with 54% of the children between the ages of 5 and 11 years. Smoking status differed by sex of the biological parent; 52% of mothers reported never smoking while only 40% of fathers had never smoked. At the same time, larger percentages (25%) of biological mothers were current smokers than fathers (20%).

Descriptive characteristics related to indicators of SES are presented in Table 2. A large percentage (84%) of the mothers had a high school diploma or greater and 70% of the children's fathers had at least a high school diploma. Slightly more than 11% of the CDS children were living in poverty and 82% of all CDS families had accumulated some positive wealth. The mean wealth of all families in 2001 was $207,669 while median wealth was $55,818. Appendix table A1 reports the prevalence of asthma using the CDS-II data in comparison to the National Health Interview Survey (NHIS). The estimates from the two sources are quite comparable. For example, for children 5-12 years old, the prevalence rate is 13.6% based on the NHIS and 13.2% based on CDS-II.

Investigating intergenerational asthma

As shown in Table 3, a total of 407 (15%) of the children from the PSID/CDS child sample had a physician diagnosis of asthma and 29% (n=674) had allergies. Eight percent of these children were taking asthma medication at the time of the interview. The type of asthma medication (long-term controller versus short-acting beta$_2$-agonist use) was not identified in these data. Data on health care utilization and wheezing in the past 12 months indicates that 21% of the children diagnosed with asthma had been to a hospital emergency room for asthma or wheezing, 48.5% had been seen at a doctor's office or health care clinic for asthma or wheezing; and 35.3% had missed at least one day of school because of asthma symptoms or wheezing (data not shown in table).

A little over 20% of children in the CDS-II had at least one biologic parent with a history of asthma, 17% had at least one biologic grandparent with a history of asthma.

Results of the multivariate logistic regression assessing childhood asthma

Table 4 shows the results of multivariate logistic regression to determine the association between family history and childhood asthma. None of the demographics, behavioral or SES characteristics were significantly related to childhood asthma at the 5% confidence level. However, family history was strongly related to childhood asthma. Overall, the odds for childhood asthma increased by 1.96 (95% CI: 1.26-3.05) for children with a parent with asthma compared to those with a parent without asthma. Children with parents and grandparents with asthma were four times more likely to have an asthma diagnosis (OR=4.27; 95% CI: 2.39-7.65) than children with neither a parent or grandparent having asthma. Children whose grandparents have asthma but parents do not have asthma were 1.52 (95% CI: 0.98-2.35) times more likely to have asthma. While not significant at the 5% level, this difference is significant that the 10% level with the p-value of 0.0593.

Discussion

The primary findings of this study are that children with parents with asthma are more likely to receive a diagnosis of asthma and that the influence of the grandparental relationship on asthma is also important. Children with a parent with asthma were about twice as likely to have asthma, and those with a parent and grandparent with asthma were four times more likely to have asthma, regardless of gender, ethnic background and birth order. These results reinforce previous findings that show an association between paternal influence on asthma risk that may be genetically or both genetically and environmentally mediated.[21, 27-28, 33-35]

Based on the analysis reported, an intergenerational influence remains beyond parental education and SES and may be a more robust indicator of childhood asthma risk.[36] Our results support those of others that have found an association between family history and asthma prevalence rates regardless of SES.[37-40] While long-term poverty and environmental exposures, especially in urban areas, contribute to asthma [37-39], they appear to interact with an individual's intergenerational history and may not determine asthma on their own.

Study findings indicate that regardless of parental asthma status having a grandparent with asthma is associated with childhood asthma. Given the increasing number of grandparents that serve as custodial caregivers or child caretakers, physicians may encounter a number of grandparents at asthma care appointments.[41-42] These encounters may provide the opportunity to engage grandparents in the communication and disclosure of family asthma history. If minority families suffering disproportionately from asthma are exposed to similar environmental and SES factors it most likely is of benefit to identify and classify grandparental asthma status as part of pediatric patients' family history.

Given the prevalence of asthma in specific populations, it appears that the collection of asthma family history in first degree relatives may have a positive predictive value for capturing the probability of childhood asthma.[43] Further research is warranted to better understand the influence of grandparental asthma status on child's asthma as well as investigating of the association of lineage (maternal or paternal), age of onset and sex of grandparent with asthma.[43] Additionally, the identification of measures (i.e. definition of positive family history and mode of collection) and communication strategies to limit bias due to recall and increase accuracy of report of asthma family history within clinical settings are needed.

Limitations

A few limitations to this study exist. First, asthma diagnosis is self-reported and collected by a positive response to a single item. As is the case with the survey question used in the BRFSS, this allows for the assessment of physician diagnosis only. Without additional questions (i.e., on asthma symptoms) we cannot determine whether the prevalence rate was underestimated, or whether due to changes in diagnostic criteria, or if the rate was in fact an over estimate.[18] Second, Burke and colleagues (2003) caution that although a positive family history predicts an increased risk of asthma, the report of a family history may only identify a small number of children at risk (i.e., sensitivity).[15, 43] In this study, we have controlled for additional asthma related factors and included them in our model (e.g., birth order, education and SES). Third, we did not present sibling data separately in this study. However, no significant differences in findings were found when the analysis was conducted without the inclusion of siblings.

Conclusions

Children in this national cohort study with parents and grandparents with a physician diagnosis of asthma were more likely to have asthma. These findings provide support for the collection of family asthma history, including grandparental asthma status, as part of the identification and diagnosis of childhood asthma. Clinicians, specifically pediatricians, may be able to use parent and grandparent family history as an indicator for identification of asthma in early childhood and to determine need for diagnostic assessments. In summary, the current study confirms a strong association between intergenerational family and childhood asthma.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Table 1
Descriptive characteristics of the asthma sample (N=2552)

	Weighted %
Male	50.63
Female	49.37
Caucasian	80.52
African American	19.48
Age 5-11	54.34
Age 12-19	45.66
Birthweight:	
Normal (>2500 grams)	94.15
LBW (1500-2499 grams)	5.00
VLBW (<1500 grams)	0.84
Spent time in a neonatal intensive care unit at birth	11.49
Biological Mom Smoking Status:	
Current Smoker	24.50
Past Smoker	20.37
Never Smoker	51.51
Missing	3.61
Biological Dad Smoking Status:	
Current Smoker	20.27
Past Smoker	18.88
Never Smoker	40.04
Missing	20.82

Note: LBW, low birth weight and VLBW, very low birth weight.

Table 2

Descriptive characteristics related to indicators of SES of the asthma sample (N=2552)

	Weighted %
Biological Mom's Educational level:	
< High School	9.0
High School	29.5
Some college	29.7
College or more	24.4
Missing	7.5
Biological Dad's Educational level:	
< High School	6.3
High School	24.0
Some college	18.8
College or more	27.4
Missing	23.5
Wealth Quartiles:	
1: Bottom 25%	17.9
2: Quartile 2	21.7
3: Quartile 3	26.5
4: Top 25%	33.9
Wealth for all families:	
Mean	$207,669
Median	$55,818

Table 3
Intergenerational asthma among child sample (N=2552)

	N	Weighted %
Child with asthma	407	14.54
Child with allergies	674	29.10
Child taking asthma med	237	7.96
Mom with asthma	343	13.36
Mom missing asthma status	106	3.52
Dad with asthma	195	9.44
Dad missing asthma status	759	21.00
Grandparent with asthma	392	17.24
Grandparent missing asthma status	768	22.66

Table 4

Results from the multivariate regression adjusted for birth order, parental education and missing data

	PROC GENMOD with repeated measures Correlated Data (Siblings)	
	OR (CI)	p
Male	1.30 (0.96-1.74)	0.0854
Black	1.41 (0.96-2.07)	0.0809
Age 5-12	1.17 (0.87-1.58)	0.2897
Mom HS v. < HS	1.16 (0.84-1.61)	0.3637
Dad HS v. < HS	0.69 (0.46-1.02)	0.0626
Dad Current Smoker v. Never	1.12 (0.77-1.64)	0.5382
Mom Current Smoker v. Never	1.12 (0.79-1.58)	0.5242
Family Relationships Examined		
Parent (either mother or father) Asthma and No Grandparent Asthma	1.96 (1.26-3.05)	**0.0027**
Parent Asthma and Grandparent Asthma	4.27 (2.39-7.65)	**<.0001**
No Parent Asthma and Grandparent Asthma	1.52 (0.98-2.35)	**0.0593**
Missing Parent Asthma and Grandparent Asthma	1.00 (0.06-17.65)	0.9977
Missing Parent Asthma and No Grandparent Asthma	4.23 (.75-24.06)	0.1035
Parent Asthma and Missing Grandparent Asthma	1.72 (0.91-3.23)	0.0925
No Parent Asthma and Missing Grandparent Asthma	0.67 (0.41-1.09)	0.1088

Note: Reference group in model is "No Parent Asthma and No Grandparent Asthma." Parent asthma represents either maternal or paternal asthma status and grandparent asthma represents either grandmother or grandfather asthma. The model presented is adjusted for birth order, parental education and missing data. OR = odds ratio and CI = 95% confidence interval.