
Associations of physician-diagnosed asthma with country of residence in the first year of life and other immigration-related factors: Chicago Asthma School Study

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Background: Among Mexican Americans in the United States, US-born children have higher rates of asthma than their Mexico-born peers.

Objective: To evaluate the associations of immigration-related variables with physician-diagnosed asthma in a sample of Mexican American children.

Methods: We analyzed data from the ongoing Chicago Asthma School Study, a population-based cross-sectional study, for 10,106 Mexican American schoolchildren in Chicago, Illinois.

Results: Mexican American children who lived in the United States in the first year of life were more likely to have physician-diagnosed asthma than their peers who lived in Mexico in the first year of life, independent of age, sex, income, language, and country of birth (odds ratio [OR], 1.79; 95% confidence interval [CI], 1.09–2.94). The risk of asthma in US-born children was higher (but not significantly) than that observed in Mexico-born children after accounting for covariates, including country of residence in the first year of life (OR, 1.37; 95% CI, 0.86–2.18). Long-term immigrants (lived in the United States for ≥ 10 years) had an increased risk of asthma compared with short-term immigrants (lived in the United States for < 10 years), independent of country of residence in the first year of life (OR, 1.93; 95% CI, 1.00–3.73).

Conclusion: These findings confirm the importance of early childhood exposures and environmental factors that are modified with migration and acculturation in asthma development.

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INTRODUCTION

Asthma is one of the most common chronic conditions of childhood. Studies^{1–7} have documented variations in the rates of asthma and respiratory symptoms within and between countries. In the United States, racial and ethnic differences in the prevalence of asthma and asthma-related symptoms have been demonstrated in several studies,^{2,8–10} with lower rates of asthma reported in Mexican Americans. In Mexican Americans, the prevalence rates of asthma, respiratory symptoms, and positive skin test results were higher in those born in the United States than in their peers born in Mexico,^{10–12} and the prevalence of asthma in Mexico-born immigrants increased with longer residence in the United States.¹¹ The reasons for these variations in Mexican Americans are still

unknown. Whether the reduced risk of asthma in Mexico-born Mexican Americans is due to factors related to country of birth per se, place of residence early in life, or both requires additional study.

In this analysis we used data from the ongoing Chicago Asthma School Study (CASS), a population-based cross-sectional study, of 10,106 Mexican American children (1) to examine the relationship between country of residence in the first year of life and physician-diagnosed asthma, (2) to evaluate the independent effects of country of residence in the first year of life and country of birth on the risk of physician-diagnosed asthma, and (3) to determine the associations of physician-diagnosed asthma with length of residence in the United States in Mexico-born Mexican children.

MATERIALS AND METHODS

Design and Data Collection

This cross-sectional analysis was based on data from the ongoing CASS, which was initiated in 1997 to survey students in selected schools in inner-city Chicago. The purpose of CASS is to identify students with asthma and respiratory symptoms in those schools and to facilitate their access to health care. The study was approved by the institutional review board of the University of Illinois at Chicago. Schools are selected in multiple ways: (1) schools are approached by

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the study team and are invited to participate, (2) schools hear about the study and approach the study team to request study services, and (3) schools are recommended to the study team by health care providers and other community stakeholders aware of the services provided by the study. The school principal or assistant principal is then contacted and informed about the study. If a school is interested in the study, a screening survey accompanied with a cover letter is distributed to all students attending the school. Students are instructed to take the survey to their parents or guardians to complete. The completed surveys are returned to a specified drop box located in their classroom and then are collected by the study team. In this analysis we included data from 20 Chicago public schools in which most of the students were Hispanics. The present analysis was limited to participants whose parents completed the screening survey of CASS between January 2004 and May 2005. During this period, the screening survey of CASS was distributed to all 19,482 students in the selected schools (prekindergarten through eighth grade). A total of 13,784 students returned a completed survey, a response rate of approximately 71%. The final study population comprised 10,106 students of Mexican descent who were born in the United States or in Mexico.

Questionnaire

The screening survey used in the CASS includes a modified version of questions contained in the core questionnaire used by the International Study of Asthma and Allergies in Childhood.¹³ Physician-diagnosed asthma is determined by the question, "Has your child ever been diagnosed by a doctor or other health care provider as having asthma?" Wheezing in the past year is determined by the question, "Has your child had episodes of wheezing (whistling in the chest) in the past 12 months?" Exercise-induced wheezing in the past year is assessed by asking, "In the past 12 months, have you heard your child wheeze or cough during or after active play?" Utilization of health care services in the past year because of wheezing is determined by the question, "In the past 12 months, has your child been to a doctor, an emergency room, or a hospital for wheezing?" Parents are asked to indicate whether their family is of Mexican descent. In families of Mexican descent, country of birth is evaluated by the question, "In what country was your child born?" Country of residence during infancy is determined by the question, "In what country did your child spend the first year of life?" In some analyses, we combined data from the 2 variables (country of birth and country of residence in the first year of life) to create a 4-level nominal variable (country of residence at age 0–1 year). The 4 levels were coded as US-born who lived in the United States in the first year of life, US-born who lived in Mexico in the first year of life, Mexico-born who lived in the United States in the first year of life, and Mexico-born who lived in Mexico in the first year of life. Length of residence in the United States is ascertained by the question, "How long has your child lived in the United States?"

Statistical Analysis

We used Pearson χ^2 statistics to compare proportions of categorical variables. The mean age was compared using 1-way analysis of variance (with age as the outcome variable). Bivariate and multivariable generalized estimating equation logistic regression analyses were performed (accounting for clustering by family) to examine the crude and adjusted associations of diagnosed asthma with country of residence in the first year of life, country of birth, and length of residence in the United States.

To examine the effects of long-term residence in the United States we limited the analyses examining the associations of asthma with length of residence in the United States to participants 11 years and older. In these analyses we categorized participants into 3 groups: (1) US-born, (2) Mexico-born who lived for 10 years or more in the United States, and (3) Mexico-born who lived in the United States for less than 10 years. Age was treated as a continuous variable in analyses examining the associations of asthma with length of residence in the United States. In this study data on income and other socioeconomic factors were not collected. As a proxy measure of socioeconomic status a new variable was created (referred to as *income* hereafter) by assigning the percentage of low-income students in the school to each student in that school. The percentage of low-income students in the school is included in the school report card provided by Chicago Public Schools. School reports are available at the Chicago Public Schools Office of Research, Evaluation, and Accountability Web site (<http://research.cps.k12.il.us/resweb/schoolqry>). Low-income students as defined in the school report card "come from families receiving public aid; live in institutions for neglected or delinquent children; are supported in foster homes with public funds; or are eligible to receive free or reduced-price lunches." In the present study income was categorized into 3 groups: less than 93%, 93% to 96%, and 97% and greater.

The potential confounding variables explored in this study included age, sex, income, language, school, and country of birth. None of these covariates confounded the associations of physician-diagnosed asthma with country of residence in the first year of life, country of birth, or length of residence in the United States (in participants aged ≥ 11 years). Nonetheless, the final models examining the associations of asthma with country of residence in the first year of life or country of birth were adjusted for age, sex, income, and language.

We tested for interactions of country of residence in the first year of life and country of birth with age, sex, language, and income by including the interaction terms in the generalized estimating equation logistic regression models. We also tested for the interaction of country of residence in the first year of life with country of birth by adding the product term to the multiple logistic regression models. In this study statistical significance was set at $P < .05$. All statistical analyses were performed using a software program (SAS version 9.1; SAS Institute Inc, Cary, North Carolina).

RESULTS

Of 10,106 students of Mexican descent selected to participate in the present study, 8,003 (79.19%) were born in the United States and 2,103 (20.81%) were born in Mexico. Table 1 provides the characteristics of the respondents and the bivariate associations of country of residence in the first year of life with asthma, respiratory symptoms, and various factors. Students who spent the first year of life in the United States were significantly younger, were more likely to be female, and were more likely to come from schools with fewer low-income students than their peers who lived in Mexico during the first year of life. Compared with children who lived in Mexico in the first year of life, those who lived in the United States in the first year of life were significantly more

likely to report an asthma diagnosis, wheeze in the past year, and wheeze or cough after exercise in the past year and to use health care services in the past year because of wheezing.

As given in Table 2, US-born children had more than twice the prevalence of asthma observed in their peers born in Mexico. Among Mexico-born participants 11 years or older, the prevalence of asthma in those who lived in the United States for 10 years or more was almost twice that observed in their peers who lived in the United States for less than 10 years. Boys reported significantly higher asthma prevalence than girls. The prevalence of asthma was inversely and significantly associated with income (percentage of low-income students in the school where the child was enrolled [an aggregate measure], $P = .001$ for trend, data not shown).

Table 1. Characteristics of Mexican American Children by Country of Residence in the First Year of Life^a

Variable	Overall	Country of residence in the first year of life		P value ^b
		United States	Mexico	
Physician-diagnosed asthma				<.001
Yes	865 (8.62)	777 (9.68)	81 (4.20)	
No	9,174 (91.38)	7,251 (90.32)	1,847 (95.80)	
Wheeze in the past year				<.001
Yes	662 (6.59)	575 (7.16)	80 (4.16)	
No	9,378 (93.41)	7,457 (92.84)	1,845 (95.84)	
Exercise-induced wheeze or cough in the past year				.002
Yes	989 (9.86)	829 (10.33)	153 (7.96)	
No	9,040 (90.14)	7,196 (89.67)	1,768 (92.04)	
Hospital or physician visit due to wheeze in the past year				<.001
Yes	443 (4.43)	399 (4.98)	39 (2.04)	
No	9,562 (95.57)	7,607 (95.02)	1,877 (97.96)	
Sex				.007
M	4,863 (48.58)	3,838 (47.89)	983 (51.33)	
F	5,147 (51.42)	4,177 (52.11)	932 (48.67)	
Age, y				<.001
<7	2,176 (22.00)	1,856 (23.43)	296 (15.66)	
7–12	6,570 (66.42)	5,256 (66.35)	1,264 (66.88)	
≥13	1,145 (11.58)	810 (10.22)	330 (17.46)	
Subtotal, No. (mean age, y)	9,891 (9.43)	7,922 (9.28)	1,890 (10.11)	<.001 ^c
Country of birth				<.001
United States	8,003 (79.19)	7,856 (97.17)	82 (4.24)	
Mexico	2,103 (20.81)	229 (2.83)	1,854 (95.76)	
Length of residence in the United States, y ^d				.89
≥10	197 (25.13)	21 (25.61)	174 (24.93)	
<10	587 (74.87)	61 (74.39)	524 (75.07)	
Language				<.001
English or bilingual	3,608 (35.70)	3,320 (41.06)	257 (13.27)	
Spanish	6,498 (64.30)	4,765 (58.94)	1,679 (86.73)	
Income ^e				<.001
<93%	1,733 (17.15)	1,394 (17.24)	322 (16.63)	
93%–96%	3,494 (34.57)	2,855 (35.31)	606 (31.30)	
≥97%	4,879 (48.28)	3,836 (47.45)	1,008 (52.07)	

^a Data are given as number (percentage) except where indicated otherwise. Sample sizes vary because of missing data.

^b For overall variations by country of residence in the first year of life based on Pearson χ^2 test statistics.

^c Based on analysis of variance, with age as the outcome variable and country of residence in the first year of life as the independent variable.

^d Mexico-born participants 11 years or older.

^e Percentage of low-income students in the school attended by the child.

Table 2. Prevalence of Physician-Diagnosed Asthma According to Respiratory, Demographic, and Immigration-Related Factors^a

Variable	Participants, No.	Participants with asthma, %	P value ^b
Wheeze in the past year			
Yes	653	61.26	<.001
No	9,359	4.86	
Exercise-induced wheeze or cough			
Yes	976	44.67	<.001
No	9,024	4.63	
Dry cough in the past 12 mo			
Yes	1,608	31.59	<.001
No	8,370	4.16	
Hospital or physician visit due to wheeze			
Yes	439	59.68	<.001
No	9,535	6.16	
Sex			
M	4,834	10.49	<.001
F	5,113	6.75	
Age, y			
<7	2,156	7.98	.50
7–12	6,537	8.78	
≥13	1,139	8.78	
Country of birth			
United States	7,948	9.69	<.001
Mexico	2,091	4.54	
Length of residence in the United States, y ^c			
≥10	196	8.16	.35
<10	585	4.27	
Language			
English or bilingual	3,583	10.02	<.001
Spanish	6,456	7.84	
Income ^d			
<93%	1,727	7.47	.002
93%–96%	3,465	7.76	
≥97%	4,847	9.63	
County of birth–country of residence			
US-US	7,803	9.74	<.001
US-Mexico	82	6.10	
Mexico-US	225	7.56	
Mexico-Mexico	1,846	4.12	

^a Sample sizes vary because of missing data.^b Based on Pearson χ^2 test statistics.^c In Mexico-born participants 11 years or older.^d Percentage of low-income students in the school attended by the child.

Significant variations in asthma rates were observed among schools (data not shown).

In logistic regression analyses children who lived in the United States in the first year of life had a 2.39-fold (95% confidence interval [CI], 1.86–3.06) increased risk of physician-diagnosed asthma compared with those who spent the first year of life in Mexico, after adjusting for age, sex, income, and language (Table 3). This increased risk persisted, although it diminished, after further adjustment for country of birth (OR, 1.79; 95% CI, 1.09–2.94). We found no statistical evidence for interactions of country of residence in the first year of life with age, sex, income, language, or country of birth.

The US-born children were at increased risk for asthma (OR, 2.24; 95% CI, 1.78–2.83) compared with their Mexico-born peers after adjusting for age, sex, income, and language. However, this relationship declined and became nonsignificant after adjustment for country of residence in the first year of life (OR, 1.37; 95% CI, 0.86–2.18).

In further analyses we used a 4-level nominal variable combining the 2 variables country of birth and country of residence in the first year of life (Table 3). Compared with Mexico-born children who lived in Mexico in the first year of life, the ORs for physician-diagnosed asthma for US-born children who lived in the United States in the first year of life, for US-born children who lived in Mexico in the first year of

Table 3. Crude and Adjusted Associations of Physician-Diagnosed Asthma With Country of Residence in the First Year of Life and Country of Birth^a

	Crude OR (95% CI)	Adjusted OR (95% CI) ^b	Adjusted OR (95% CI) ^c
Country of residence in the first year of life ^d	2.35 (1.84–2.99)	2.39 (1.86–3.06)	1.79 (1.09–2.94)
Country of birth ^e	2.21 (1.76–2.77)	2.24 (1.78–2.83)	1.37 (0.86–2.18)
Country of birth–country of residence in the first year of life ^f			
US-US	2.42 (1.89–3.12)	2.48 (1.92–3.20)	NA
US-Mexico	1.60 (0.66–3.89)	1.66 (0.68–4.03)	NA
Mexico-US	1.87 (1.07–3.25)	1.91 (1.10–3.32)	NA
Mexico-Mexico	1 (Reference)	1 (Reference)	NA

Abbreviations: CI, confidence interval; NA, not applicable; OR, odds ratio.

^a The sample size used in the logistic regression analyses presented in this table was 9,673.

^b Adjusted for age, sex, language, and income.

^c Adjusted for age, sex, language, income, and country of birth (with country of residence in the first year of life as the main exposure variable) or country of residence in the first year of life (with country of birth as the main exposure variable).

^d Based on logistic regression models treating country of residence in the first year of life (United States vs Mexico) as the main exposure variable.

^e Based on logistic regression models treating country of birth (United States vs Mexico) as the main exposure variable.

^f Based on logistic regression models treating the country of birth–country of residence in the first year of life variable (4-level nominal variable) as the main exposure variable.

life, and for Mexico-born children who lived in the United States in the first year of life were 2.48 (95% CI, 1.92–3.20), 1.66 (95% CI, 0.68–4.03), and 1.91 (95% CI, 1.10–3.32), respectively, after accounting for covariates.

Table 4 gives the associations of physician-diagnosed asthma with length of residence in the United States in participants 11 years or older. Compared with Mexico-born children who lived in the United States for less than 10 years, US-born children and Mexico-born children who lived for 10 years or more in the United States had an increased risk of asthma after adjusting for age, sex, income, and language; the respective ORs were 2.57 (95% CI, 1.68–3.95) and 1.94 (95% CI, 1.01–3.74). The ORs after adjustment for country of residence in the first year of life were 1.69 (95% CI, 0.77–3.71) and 1.93 (95% CI, 1.00–3.73). In this age group, participants who spent the first year of life in the United

States had 2.18-fold increased odds of asthma (95% CI, 1.50–3.16) after accounting for covariates. This increased odds of asthma persisted but became nonsignificant after adjustment for length of residence in the United States (OR, 1.62, 95% CI, 0.76–3.45). In this analysis, there was no statistically significant evidence of interactions of length of residence in the United States with age, sex, language, income, and country of residence in the first year of life.

DISCUSSION

This study demonstrated that Mexican American children who lived in the United States in the first year of life were more likely to have physician-diagnosed asthma than their peers who lived in Mexico in the first year of life, independent of age, sex, income, language, and country of birth. The risk of asthma in US-born children was higher (but not

Table 4. Crude and Adjusted Associations of Physician-Diagnosed Asthma With Length of Residence in the United States and Country of Residence in the First Year of Life^a

	Crude OR (95% CI)	Adjusted OR (95% CI) ^b	Adjusted OR (95% CI) ^c
Length of residence in the United States ^d			
US-born	2.55 (1.67–3.87)	2.57 (1.68–3.95)	1.69 (0.77–3.71)
Mexico-born, lived in the United States for ≥10 y	1.92 (1.00–3.71)	1.94 (1.01–3.74)	1.93 (1.00–3.73)
Mexico-born, lived in the United States for <10 y	1 (Reference)	1 (Reference)	1 (Reference)
Country of residence in the first year of life ^e			
United States	2.13 (1.49–3.06)	2.18 (1.50–3.16)	1.62 (0.76–3.45)
Mexico	1 (Reference)	1 (Reference)	1 (Reference)

Abbreviations: CI, confidence interval; OR, odds ratio.

^a In participants 11 years or older. The sample size used in the logistic regression analyses presented in this table was 2,943.

^b Adjusted for age (treated as continuous variable), sex, language, and income.

^c Adjusted for age (treated as continuous variable), sex, language, income, and country of residence in the first year of life (with length of residence in the United States as the main exposure variable) or length of residence in the first year of life (with country of residence in the first year of life as the main exposure variable).

^d Based on logistic regression models treating length of residence in the United States (3 categories as indicated in the table) as the main exposure variable.

^e Based on logistic regression models treating country of residence in the first year of life (United States vs Mexico) as the main exposure variable.

significantly) than that in Mexico-born children after accounting for covariates, including country of residence in the first year of life. Among Mexico-born participants, long-term immigrants (lived in the United States for ≥ 10 years) had an increased risk of asthma compared with short-term immigrants (lived in the United States for < 10 years), independent of country of residence in the first year of life.

Although no previous studies, to our knowledge, have examined the effect of country of residence in the first year of life independent of country of birth, the present results are consistent with previous studies^{10–12,14–18} on immigrant populations from different regions of the world showing that the prevalence of asthma and wheezing increased in immigrants who moved from areas where the prevalence rates of asthma and atopic disorders are low to countries experiencing high rates of these conditions. The present findings are similar to those reported in recent studies^{10–12} of Mexican Americans in the United States. A study¹² based on Third National Health and Nutrition Examination Survey data documented that US-born Mexican American children had a 2.19-fold increased risk of asthma and a 2.05-fold increased risk of wheezing in the past year compared with their Mexico-born peers after accounting for confounding variables. Another recent study¹⁰ reported that compared with non-Hispanic white children whose parents were also born in the United States, the ORs of lifetime asthma for Mexico-born children and US-born children from Mexican families born in the United States were 0.43 (95% CI, 0.29–0.64) and 1.05 (95% CI, 0.90–1.22), respectively. Holguin et al¹¹ showed that US-born Mexican American adults had more than double the risk of asthma diagnosis reported by their counterparts who were born in Mexico, independent of age, smoking, body mass index, region of survey, language, and access to health care.

The heterogeneity in the risk of asthma by place of birth or residence in the first year of life observed in several studies, including the present study, might be due to variations in environmental exposures in utero or in early childhood. The lower risk of asthma in children who lived in Mexico in the first year of life could point to early life exposures that might be protective against the development of asthma. Farm or rural residence has been inversely associated with risk of asthma and other atopic disorders in several epidemiologic investigations.^{19–26} A large proportion of Mexican immigrants immigrate to the United States from farm or rural areas in Mexico,^{27,28} and most of them move to urban areas in the United States.¹² This could explain the reduced risk of asthma observed in children born or raised in Mexico in early life and the increase in asthma prevalence in long-term Mexican immigrants in the United States. This hypothesis needs to be thoroughly examined in further investigations.

Maternal smoking, particularly during pregnancy, may increase the risk of asthma, as demonstrated by several previous studies.^{29–33} Mothers of US-born Mexican American children are more likely to smoke during pregnancy than mothers of Mexico-born participants.¹² Studies have also demonstrated an inverse relationship between acculturation and

maternal smoking during pregnancy.³⁴ Eldeirawi and associates¹² found that US-born children had an increased risk of asthma independent of maternal smoking during pregnancy. Holguin et al¹¹ also adjusted for smoking and demonstrated an elevated risk of asthma in US-born Mexican American adults compared with Mexico-born Mexican immigrants.

The present study showed that the risk of asthma in participants who lived in the United States for 10 years or more was almost twice that observed in those who lived in the United States for less than 10 years independent of country of residence in the first year of life. These results are similar to those demonstrated by Holguin et al,¹¹ who found that Mexican participants who lived in the United States for more than 10 years had a 1.60-fold risk of asthma compared with their counterparts with less than 10 years of residence in the United States, after accounting for age. These results suggest that the protective effect of birth in Mexico or residence in Mexico in the first year of life diminishes after prolonged residence in the United States. This points to environmental, dietary, and lifestyle factors that might be linked to the risk of asthma and modified with immigration, acculturation, and prolonged residence in the United States.

Inverse associations of dietary factors, such as fruit intake; vitamins A, C, and E; dietary fish; and n-3 polyunsaturated fatty acids, with asthma, ventilatory function, and respiratory symptoms^{35,36} have been reported in the literature. Mexican American adults born in Mexico also have been reported to consume less fat and more fiber; vitamins A, C, E, and B6; folate; calcium; potassium; and magnesium than their counterparts born in the United States.³⁷ In another study,³⁸ first-generation Mexican American women were found to have significantly greater intake of protein, carbohydrates, cholesterol, vitamins A and C, folic acid, and calcium than second-generation Mexican American or white non-Hispanic women. Other studies found inverse associations between length of residence in the United States among Mexican women and consumption of vitamin A- and vitamin C-rich fruits and vegetables.³⁹ Therefore, it is possible that the lower risk of asthma in children born or raised for the first year of life in Mexico is due in part to changes in diet and dietary practices in Mexican immigrants. The associations of immigration with dietary factors and how they affect the risk of asthma should be examined in prospective studies.

Some studies^{40–44} have reported a protective effect of breastfeeding against the development of asthma or atopy. Eldeirawi and coauthors¹² showed that Mexico-born Mexican American children were more likely to be breastfed than their US-born peers. Although data on breastfeeding were not obtained as part of the present study, breastfeeding did not explain the increased risk of asthma among US-born children compared with their Mexico-born counterparts, as noted in previous investigations.¹²

Other alternative explanations for the heterogeneity in the prevalence of asthma should be considered. First, it is possible that the increased risk of asthma in US-born children reflects a detection bias because US-born Mexican children

and adults have higher levels of insurance coverage and access to health care.^{11,12,45} Although we had no data on insurance coverage or access to health care, the results persisted after accounting for school and the percentage of low-income students in the school, a proxy measure of income or socioeconomic status. In the present study US-born children were significantly more likely to report respiratory symptoms that do not usually require a physician diagnosis. In previous studies^{11,12} access to health care and insurance coverage did not explain the increased risk of asthma in US-born Mexican American adults and children.

Differences in the risk of asthma by country of birth, residence in the first year of life, and prolonged residence in the United States noted in this study could be due to self-report biases due to linguistic differences. In this study the observed associations persisted after we adjusted for language in which the survey was completed. We also found no interactions of country of birth, country of residence in the first year of life, and length of residence in the United States with language. These findings are consistent with those of other studies^{11,12} in which language did not explain the relationship between country of birth and asthma. It could still be argued that the observed associations are due to cultural factors, such as perception of pain, health, and wellness. Little is known about how such factors change with migration and how they can affect the risk of asthma, and, therefore, further research is needed in this area.

This study has certain limitations. First, the study is cross-sectional and could not be used to establish a causal link between country of birth or country of residence early in life and the development of asthma. Second, this study relied on self-report and, therefore, could be subject to misclassification or recall bias. Third, the study did not collect information on several covariates that may confound the associations observed in the study, and, thus, we did not adjust for or examine additional potential confounding variables or effect modifiers.

Overall, this study used a large sample of Mexican American children in an urban setting. This study is the first, to our knowledge, to highlight the effect of country of residence in the first year of life independent of country of birth on the risk of asthma in Mexican American children and is the first in the literature, to our knowledge, to examine the impact of length of residence in the United States on risk of asthma in immigrant Mexican children. The findings of this study confirm the potential importance of early childhood exposures and environmental factors that are modified with migration and acculturation in the development of asthma. Additional prospective studies are warranted to examine the impact of migration on specific factors that could be related to asthma and to help us understand the etiology of the disease.

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