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ORIGINAL PAPER

Country of Birth and Variations in Asthma and Wheezing Prevalence, and Emergency Department Utilization in Children: A NHANES Study

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Abstract Asthma prevalence and asthma-related healthcare utilization differ across racial/ethnic groups and geographical areas. This study builds on previous research to examine the relationship between country of birth and asthma prevalence and healthcare utilization using a national data set. The National Health and Nutrition Examination Survey (NHANES) Demographic and Questionnaire Files from 2007 to 2012 were used for this study. We used SPSS complex sampling design to estimate the association between country of birth and asthma prevalence, wheezing and emergency department (ED) use. The sample size was 8272 children and adolescents between the ages of 5 and 19 years old. US-born children had more reported episodes of wheezing ($p = 0.024$) 95 % CI 1.06; 2.54. There was no association between country of birth and asthma and ED use. US-born children and adolescents compared to foreign-born children and adolescents are more likely to have episodes of wheezing.

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Background

Asthma is a chronic childhood disease affecting approximately 10 million US children [1]. The related burden that it places on society and the healthcare system is significant. It is estimated that asthma is the number one reason for school absenteeism and accounts for more than 13 million school days lost per year. It is the third leading cause of hospitalizations among children and accounts for (44 %) of all asthma-related hospitalizations [2]. Since 1980, asthma-related death rate for children under 19 has increased by approximately 80 % [2]. The disease disproportionately affects poor children and those from minority groups [3, 4].

Children in immigrant families, regardless of socioeconomic background, are generally found to have better health outcomes than US non-Hispanic white children despite limited access to healthcare [5]. This has been termed the epidemiological or immigrant paradox [5]. There is also a growing body of research suggesting that country of birth provides some protection against asthma for certain groups of immigrants [6–8]. However, the recent influx of immigrants has raised concerns about the burden they place on the US healthcare system [9]. In fact, the Center for Immigration Studies, reported that the number of immigrants in 2010 was 40 billion, an increase of 28 % since 2000. Additionally, more than 40 % of the uninsured children are immigrants [10]. As such, immigrant children with asthma may place strain on an already strapped emergency care system.

Various studies have examined the relationship between asthma and wheezing among foreign-born children and

adolescents versus US-born. These studies have mainly examined the Hispanic segment of the population, aggregated or in subgroups [11–18]. Few have examined the relationship between immigration and asthma related healthcare utilization. A 2007 study by Javier and colleagues used data from the California Health Interview Survey to examine the relationship between country of birth and asthma among 2600 children between the ages of 1 and 11 who have ever had asthma as reported by their parents. The results showed a correlation between emergency room visit and country or place of birth [19]. This study builds on previous studies and includes a national sample of children and adolescents from not only Spanish-speaking countries, but other countries. More specifically, this study explores the association between country of birth and prevalence of asthma and wheezing and ED utilization.

Methods

Data

We used data from the National Health and Nutrition Examination Survey (NHANES) to determine the association between country of birth and wheezing, asthma prevalence and asthma-related emergency department use. The survey was conducted by the National Center for Health Statistics (NCHS) at the Centers for Disease Control and Prevention (CDC) and includes nationally representative information on both the health and nutrition status of the general US population which was obtained through self-reported personal interviews and physical examination each year for children and adults. Data released in 2 year cycle from the demographic and questionnaire files which included Respiratory Health and Disease, Medical Conditions and Hospital Utilization and Access to Care files were used. This study included three interview cycles, 2007–2008, 2009–2010 and 2011–2012 interview cycles. Our final weighted sample included 8272 children and adolescents who met the inclusion criterion of being between ages of 5 and 19.

Variables

We explored associations between country of birth and two respiratory conditions, wheezing and asthma. We also examined the relationship between country of birth and asthma-related emergency department visits. We identified these conditions from the participant self-reports. The dependent variables wheezing, asthma prevalence, and emergency department visits were defined based on the NHANES survey questions. The Respiratory file was used to identify wheezing. The question, "In the past year, have you had wheezing or whistling in your chest?" was categorized as a dichotomous variable with 1 = yes and 0 = no. The other dependent variable, asthma prevalence was obtained from the Medical Condition file. The question used to identify self-reported asthma prevalence was: "Do you still have asthma?" This is also a dichotomous variable with 1 = yes and 0 = no. Individuals who answered no to the previous question, "Have you ever had asthma," were not asked if they still have asthma. To examine the association between country of birth and emergency department use we used the question from the Medical Condition file: "During the past 12 months, have you had to visit an emergency room or urgent care center because of asthma?" This question is only asked of those who currently have asthma. This is a dichotomous variable with 1 = yes and 0 = no.

Our primary independent variable was country of birth. This was taken from the demographic data. The question "In what country were you born?" identified those born in the 50 United States or Washington DC, Mexico, other Spanish speaking country and non-Spanish speaking country. We recoded the variable as a dichotomous variable, foreign-born versus US-born.

The covariates used were usual source of care, gender, race/ethnicity, and age. The question that was used to identify usual source of care was "Is there a place that you usually go when you are sick or need advice about your health?" This variable was recoded as a dichotomous variable 1 = yes and 0 = no. Standard forms for gender and age were used with Male = 1 and Female = 2. Age is a continuous variable. Race/ethnicity was categorized as non-Hispanic White, non-Hispanic Black, Hispanic, and other race including multi-racial. Hispanic included Mexican and non-Mexican of Hispanic origin. The control group was 'Non-Hispanic white.'

Data Analysis

All analyses were performed using the complex samples module in SPSS version 22 to adjust for the clustered hierarchical sample designs of NHANES, using cluster, stratum and sample weights provided by NCHS. Descriptive statistics were used to examine participant characteristics. Separate logistic regression models for the association between country of birth and the dependent variables (asthma, wheezing, and emergency department use for asthma) were performed. Confounding variables, age, gender, race/ethnicity and usual source of care were included in the models.

Results

Table 1 presents the descriptive characteristics of the weighted sample. The sample included a higher percentage of non-Hispanic Whites (57 %) than Hispanics (21 %) and

Table 1 Characteristics of NHANES US born and foreign born children and adolescents

Variable	Total (%)	US-born ($n = 7479$)* (%)	Foreign-born variable ($n = 793$)* (%)
Wheezing in the past 12 months			
Yes	11.7	14.0	11.9
No	88.3	86.0	73.3
Prevalence of asthma			
Yes	60.0	60.3	52.1
No	40.0	39.7	47.9
ED visits			
Yes	21.5	21.9	21.7
No	78.5	78.1	78.3
Gender			
Male	51.0	51.1	50.0
Female	49.0	48.9	50.0
Race/ethnicity			
Hispanic	20.9	18.3	53.7
Non-hispanic black	14.6	15.3	5.6
Multi-racial	7.4	6.6	17.7
White	57.0	59.7	23.0
Usual source of care			
Yes	92.4	93.9	74.4
No	7.6	6.1	25.6

* Weighted

non-Hispanic Blacks (15 %). Other racial groups comprised 7 % of the sample. Males accounted for 51 % of the sample. Blacks had a higher percentage of wheezing compared to all other racial groups. Sixty percent of the sample reported having asthma and 12 % reported having had wheezing in the last 12 months. Ninety-two percent reported having a routine or usual place of care. Only 22 % reported having had an asthma-related emergency department visit during the past 12 months. Of the sample 93 % were US-born. There was a larger percentage of Hispanics among the foreign-born (54 %). Blacks represented the smallest percentage at 6 %. Among the US-born group, Whites accounted for a larger percentage of the sample (60 %) and multi-racial group comprised the smallest percentage at 7 %. A larger percentage of US born children and adolescents (94 %) had a routine place of care compared to foreign-born (74 %). The rate of ED visits was similar for both US-born (22 %) and foreign-born (22 %). A larger percentage of US-born children and adolescents reported wheezing in the past month (14 %) compared to foreign-born (12 %) and prevalence of asthma was higher in US-born (60 %) compared to 52 % in foreign-born.

Table 2 shows the multivariate logistic regression to examine the association between country of birth and wheezing outcomes after adjusting for age, gender, race and usual place of care. Country of birth was significantly associated with wheezing. US born children and adolescents were more likely to report experiencing wheezing compared to foreign-born children and adolescents (OR 1.64, 95 % CI 1.06 2.54). The association between country of birth and wheezing differs by race. Black children and adolescents (OR 1.27, 95 % CI 1.02 1.56) were more likely to experience wheezing compared to white children and adolescents. Male children and adolescents were more likely to have episodes of wheezing (OR 1.25, 95 % CI 1.00 1.56) than females.

No significant association was found between country of birth and prevalence of asthma. The results showed, however, that there was a significant association between race and prevalence of asthma. Blacks were 1.82 times more likely to have asthma compared to Whites (95 % CI 1.35 2.45) and age was also significantly associated with asthma.

We found no significant association between country of birth and emergency department visits. However, age and race were significantly associated with ED visits ($p = 0.049$ & 0.029 respectively). Blacks were 1.96 times more likely to have an ED visit than Whites and Hispanics were 2.03 (95 % CI 1.13 3.60) times more likely to have an ED visit compared to Whites (95 %CI 1.18 3.25).

Discussion

Our findings indicate that there are significant associations between country of birth and wheezing. Children and adolescents born outside of the 50 states including

Table 2 Country of birth and wheezing, asthma, and emergency department visits

	Wheezing			Asthma			ED visits		
	OR	95 %	CI	OR	95 %	CI	OR	95 %	CI
Country of birth	1.64***	1.06	2.54	1.32	0.65	2.70	1.14	0.52	2.51
Usual source of care	1.28	0.84	1.95	1.47	0.77	2.82	1.63	0.80	3.33
Age	0.92	0.98	1.02	0.96***	0.93	0.99	0.95***	0.91	1.00
Gender	1.25***	1.00	1.56	0.83	0.59	1.17	0.73	0.50	1.09
Race/ethnicity									
Hispanic	0.82	0.66	1.02	1.17	0.84	1.62	2.03***	1.14	3.61
Black	1.27***	1.02	1.60	1.82***	1.35	2.45	1.96***	1.18	3.25
Multi-racial	1.04	0.77	1.40	0.94	0.56	1.56	1.05	0.53	2.10

Reference group for race: White

**** p value < 0.05*

Washington, DC were less likely to have reported wheezing or whistling in the chest within the last year. However, there was no significant association between country of birth and prevalence of asthma. Similarly our study showed no correlation between country of birth and emergency department visit for asthma.

First, it is important to distinguish between asthma and wheezing. Like asthma, wheezing is common in children. Wheezing is defined as a high pitched sound that is produced by air through a compressed or abnormally narrowed airway(s) and can be mistaken as asthma. However, not all wheezing is indicative of asthma [20]. Causes of wheezing in children include bronchiolitis asthma, allergies and gastro esophageal reflux disease. In some international settings, intestinal parasites may be associated with wheezing and pulmonary eosinophils [21].

Asthma is a chronic inflammatory disease that causes narrowing of the airways. It is characterized by wheezing, tightening of the chest and cough [20] and responds to corticosteroids. According to Gong, wheezing, however, is not always manifested during active asthma, and patients with asthma may often complain more about tightening of the chest than wheezing [20]. Previous studies have demonstrated that wheezing and asthma are independent risk factors for acute chest syndrome resulting in ED visits, and patients with wheezing do not always have a diagnosis of asthma [22].

Our finding that US born children and adolescents were more likely to have an episode of wheezing supports the immigrant paradox. One causal theory is the hygiene theory of asthma that children born in rural areas or in less developed countries are exposed to compromised sanitary conditions and childhood infections that may serve as a protective barrier against development of asthma or other respiratory diseases. This is consistent with previous studies that suggest that foreign born children and adolescents when compared to their US born counterparts are less likely to be diagnosed with wheezing and asthma [6, 16, 18, 23–25]. However, there may be other explanations of the association between wheezing and country of birth. A possible explanation might be selection bias resulting in the healthier population being granted access to the host country while those who are less healthy remain in their home country [26, 27].

Wheezing in school aged children and adolescents can be attributed to a number of factors including environmental factors, socio-economic status and the increase in the prevalence of obesity or individuals who are overweight in the United States. The hygiene hypothesis is another theory that suggests that individuals who are exposed to infections earlier in life are less likely to experience wheezing and be diagnosed with asthma. This is a result of development of the immune system [28]. Studies have linked having older siblings and daycare attendance to development of infection, which later serves as a protection against the disease [29, 30]. In an international study in which the number of the siblings and asthma prevalence were studied, there was a significant inverse relationship between increasing number of siblings and older siblings and asthma prevalence. However, the relationship was stronger in more affluent countries [30]. Other studies have linked exposure to parasites as a protective mechanism for asthma [31]. Collins and colleagues found an association between that socio-economic status and wheezing. Hispanic children from poorer neighborhoods were less likely to have episodes of wheezing [32].

Prior studies report an association between country of birth and asthma [11, 12, 18, 24]; however, the results of this study found no significant association. Previous studies suggest that the protective barrier against asthma or other respiratory diseases formed from the hygiene theory diminishes over time [15, 33].

Additionally, our study combined all Hispanics into one group and hence there were no intergroup comparisons as in previous studies. In this study, we sought to examine the

association between country of birth and emergency department utilization. The results showed no significant association between birth place and healthcare utilization. This study does not lend support to the premise that immigrants may over utilize ED services.

There are several limitations to this study. The use of the cross-sectional NHANES dataset, although it is a nationally representative dataset, does not allow us to observe changes over time among the participants and infer causality. Additionally, the data are self-reported which have the potential for under or over reporting information. The data do not provide information on specific countries of birth. Information is provided for Spanish speaking countries and non- Spanish speaking. For this study we combined those two groups, non-Spanish speaking and Spanish speaking countries. Additional study is needed to examine the differences between the two groups. We did not include details on the length of time foreign born lived in the US which may have affected their reaction to certain diseases. Future studies using longitudinal data and specific countries of birth are needed to provide additional insight.

Conclusions

US-born children and adolescents compared to their foreign-born counterparts are more likely to have episodes of wheezing. There was no relationship between country of birth and asthma or emergency department use. Country of birth and wheezing prevalence should be highlighted in policy discussions of broader issues on health disparities. The current focus of health disparities is on racial/ethnic differences along with geographic variation. This study further challenges us to consider other within-group variations. Further research is needed to better understand the mechanisms by which this variation in wheezing occurs, such as the role that natural and built environments may play in explaining the observed disparities. This knowledge can be used to design interventions that target specific risk factors or mechanisms of resiliency, and in the development of policies that may mitigate wheezing prevalence in the US.

Finally, the expansion of insurance through the Affordable Care Act can increase access to healthcare [34, 35], and may mitigate incidence and prevalence of asthma and wheezing. Further research may help assess the impact on disparities in the disease and ED use among this population.

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