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Influenza Burden for Children With Asthma

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ABSTRACT

OBJECTIVE. The goal was to estimate the influenza disease burden among children with asthma and among healthy children by using active, laboratory-confirmed, population-based surveillance.

METHODS. Children 6 to 59 months of age residing in 3 US counties who were hospitalized with acute respiratory illnesses or fever were enrolled prospectively from 2000 through 2004. Similar children who presented to clinics and emergency departments during 2 of the influenza seasons (2002–2004) were enrolled. Rates of influenza-attributable outpatient visits and hospitalizations for children with asthma and for healthy children were estimated. History of asthma and receipt of influenza vaccine for the study children were determined through parental report. The prevalence of asthma in the surveillance population was assumed to be 6.2% for children 6 to 23 months of age and 12.3% for children 24 to 59 months of age.

RESULTS. Of 81 children 6 to 59 months of age with influenza-confirmed hospitalizations in 2000 to 2004, 19 (23%) had asthma. Average annual influenza-attributable hospitalization rates were significantly higher among children with asthma than among healthy children 6 to 23 months of age (2.8 vs 0.6 cases per 1000 children) but not children 24 to 59 months of age (0.6 vs 0.2 case per 1000 children). Of 249 children 6 to 59 months of age with influenza-confirmed outpatient visits in 2002 to 2004, 38 (15%) had asthma. Estimated outpatient influenza-attributable visit rates were higher among children with asthma than among healthy children 6 to 23 months of age (316 vs 152 cases per 1000 children) and 24 to 59 months of age (188 vs 102 cases per 1000 children) in 2003 to 2004. Few parents reported that their children had been vaccinated, including <30% of children with asthma.

CONCLUSION. Influenza-attributable health care utilization is high among children with asthma and is generally higher than among healthy children.

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Key Words

influenza, asthma, epidemiology, disease burden, children, inpatient, outpatient

Abbreviations

NHIS—National Health Interview Survey
CI—confidence interval
ARI—acute respiratory illness
ED—emergency department

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INFLUENZA VIRUS IS an important cause of fever and respiratory illness. High rates of both influenza-attributable hospitalizations among children <2 years of age and influenza-attributable outpatient visits among children of all ages have been documented.^{1,2} In addition, retrospective and prospective studies have found that children and adults with underlying chronic conditions have higher rates of influenza-attributable visits than do healthy persons.^{3–5} However, the laboratory-confirmed influenza disease burden among children with asthma has not been established.

Despite long-standing annual influenza vaccination recommendations for children ≥6 months of age with specific medical conditions, including asthma,⁶ vaccination rates among children with asthma traditionally have been low (<30%).^{7–10} These low rates likely reflect the difficulty of a risk-based vaccination strategy or underappreciation of the influenza disease burden among children with asthma. Therefore, better estimates of the influenza burden among children with asthma may enhance vaccine uptake.

The New Vaccine Surveillance Network performed active, prospective, inpatient and outpatient surveillance

among children <5 years of age with acute respiratory illnesses (ARIs) or fever in 3 counties. Although we previously reported overall rates of influenza-attributable hospitalizations and outpatient visits according to age group,^{11,12} this study determined the inpatient and outpatient burdens of laboratory-confirmed influenza for children in a vaccine-targeted, high-risk group (asthma) and compared those burdens with those for healthy children 6 to 59 months of age.

METHODS

Study Design

Inpatient Surveillance

A prospective, population-based study of laboratory-confirmed, influenza-attributable hospitalizations was performed year-round in counties that included Nashville, Tennessee, and Rochester, New York, beginning October 1, 2000, and Cincinnati, Ohio, beginning October 1, 2003. All 3 sites conducted surveillance through September 30, 2004. Surveillance hospitals admitted >95% of the hospitalized children residing in each county.

Study nurses identified and enrolled children <5 years of age who were county residents and were admitted with ARI or fever to surveillance hospitals between Sunday and Thursday. Children were excluded if they had experienced respiratory symptoms for >14 days, had fever and neutropenia associated with chemotherapy, were transferred from another surveillance hospital, had been hospitalized in the 4 days before admission, or were newborns who had never been discharged from the hospital.¹²

Outpatient Surveillance

During the 2002 to 2003 and 2003 to 2004 influenza seasons, study nurses enrolled a systematic sample of children residing in each county who presented with fever or ARI to selected clinics or emergency departments (EDs). Outpatient surveillance used inclusion and exclusion criteria similar to those used for inpatient surveillance. During the influenza season, surveillance was performed 1 or 2 days per week in 1 to 4 primary care pediatric clinics per study site and 3 or 4 days per week or every fourth day in the only pediatric ED in each county. Overall, the proportions of all fever or ARI visits by county children that were evaluated in each ED varied (30% for Nashville, 70% for Rochester, and 95% for Cincinnati).¹²

Consent

Informed written consent was obtained from each child's parent or guardian before enrollment. The institutional review boards of each study site, the participating surveillance hospitals, and the Centers for Disease Control and Prevention approved the conduct of the study.

Laboratory Samples

In both settings, eligible children were enrolled and nasal swabs from the anterior nares combined with throat

swabs were tested for influenza.¹² All 4 years of inpatient samples and outpatient samples from 2003 to 2004 had both viral cultures and reverse transcription-polymerase chain reaction assays performed, whereas outpatient samples from 2002 to 2003 were tested with reverse transcription-polymerase chain reaction assays only. A specimen was defined as influenza-positive if the viral culture or duplicate reverse transcription-polymerase chain reaction assays yielded positive results for influenza A or B.^{11,13}

Influenza Season Definition for Outpatient Surveillance

Outpatient surveillance began after 2 positive tests for influenza virus or respiratory syncytial virus were identified in 2 consecutive weeks in local research or hospital laboratories (for any age); surveillance ended after 1 or no positive influenza case per week was detected in 2 consecutive weeks. The influenza season was defined as the 13 consecutive weeks that contained $\geq 95\%$ of all influenza cases.

Demographic and Clinical Information

Data Sources

Demographic information, medical and social history information, and influenza vaccination status were obtained through a standardized interview administered to the parent or guardian by study nurses.^{11,12} Parents were asked whether their child had received any influenza vaccination and whether their child had a history of asthma or any other underlying, medically diagnosed conditions. As in the 2003 National Health Interview Survey (NHIS), parents were asked, "Has a doctor ever told you that your child has asthma?" Children were classified as healthy if they had none of the following underlying conditions assessed specifically by the questionnaire and the NHIS: asthma, heart disease, sickle cell anemia, cystic fibrosis, or diabetes mellitus.¹⁴ To assess the possibility of misclassifying children with underlying conditions as healthy, all of the medical conditions reported by the parents of influenza-positive children were reviewed. Two of the hospitalized children and none of the outpatient children had underlying medical conditions that were not captured by the NHIS definition. One child had cirrhosis, and another had IgA nephropathy, ulcerative colitis, and spinal muscular atrophy.

All enrolled children underwent systematic review of their medical charts. For hospitalized children, the chart review included the admission and discharge dates, receipt of supplemental oxygen, and admission to the ICU. For all children, we collected up to 10 International Classification of Diseases, 9th Revision, diagnoses.¹⁵ Although we did not ascertain whether wheezing was documented in the medical chart, we did capture discharge diagnoses including asthma (code 493.x), bronchiolitis (code 466 or 466.1), or wheezing (code 786.07).

Classification for Children With Asthma

The 2003 NHIS was used to assess the lifetime prevalence of asthma among children 6 to 59 months of age.¹⁴ With the 2003 NHIS question ("Has a doctor or other

health professional ever told you that your child has asthma?"), 6.2% of US children 6 to 23 months of age and 12.3% of those 24 to 59 months of age were reported to have a history of asthma. To estimate the number of children in each county with asthma (denominator), we assumed that our county surveillance populations had this national prevalence of asthma. Although asthma prevalence has been shown to vary according to region, national asthma prevalence estimates were comparable to those for children in Tennessee, New York, and Ohio and to county-based estimates among all persons in surveillance counties.^{16,17}

Classification for Healthy Children

We assumed that our county surveillance population had the same proportions of healthy children as the NHIS results, that is, 92.3% for children 6 to 23 months of age and 85.2% for children 24 to 59 months of age.

Data Analyses

Estimated Influenza-Attributable Rates Among Children With Asthma and Healthy Children

Hospitalization Rates

For the surveillance population, we previously reported hospitalization rates for all children <5 years of age by using weighted numbers of enrolled children with influenza divided by population denominators from the US Census.^{11,12} The weighting estimated the total rate if surveillance had been performed every day, rather than 4 days per week, and all eligible children were enrolled. The rates for 6- to 59-month-old children with asthma were calculated similarly, with numerators equal to the weighted number of influenza-positive children with asthma identified through the parental interviews. Denominators were the age-specific 2000 US Census county populations multiplied by the proportion with asthma, as estimated from NHIS data. The 95% confidence intervals (CIs) for average inpatient rates for children with asthma and healthy children, according to age group, were calculated by using 500 bootstrap samples (resampling the original data with replacement 500 times). The estimated rates of influenza infections among healthy children were similar whether the 2 children with underlying medical conditions not captured by the NHIS were included or excluded; therefore, they were excluded.

Outpatient Clinic and ED Visit Rates

We previously estimated influenza-attributable outpatient visit rates as the practice-based proportion of influenza-confirmed infections for children, according to age group, during the 13-week influenza season multiplied by the estimated age-specific ARI or fever visit rate from national data.¹² In this study, we combined outpatient clinic and ED visit rates to estimate overall, influenza-attributable, outpatient visit rates for children 6 to 23 and 24 to 59 months of age during the 13-week influenza season, by using analogous assumptions and methods. To estimate rates for children with asthma, we identified the proportion of influenza-positive children

who had asthma (from the parental interviews) for the numerator. For the denominator, we assumed that county children had the same rates of asthma as the national estimates from the NHIS. The annual average number of influenza-attributable outpatient visits per 1000 children with asthma equaled the influenza-attributable rate for all children multiplied by the proportion of influenza-positive children with asthma and divided by the national estimate of children with asthma from the NHIS. The 95% CIs were calculated by using Confidence Interval Analysis 2.0.0 (University of Southampton, Southampton, United Kingdom).¹⁸ We performed analogous calculations for healthy children in the inpatient and outpatient settings by using estimates from the NHIS.

Clinical Severity

The Mann-Whitney *U* test was used to compare the median duration of hospitalization among influenza-positive children with asthma and healthy children. For dichotomous comparisons, the χ^2 test was used.

Characteristics and Parent-Reported Influenza Vaccination Status According to Age Group

To avoid bias introduced by vaccination or underlying medical conditions other than asthma, we estimated influenza vaccination status in the population by examining influenza-negative children ≥ 6 months of age who were healthy or had asthma and were enrolled in Rochester, New York, or Nashville, Tennessee. We did not include children enrolled in Cincinnati, Ohio, in this analysis because this site did not participate in all study years. We stratified the multivariate logistic regression analyses predicting parental report of influenza vaccination for children with asthma, compared with healthy children, according to age group because the influenza vaccination recommendations in 2002 to 2004 and hospitalization rates differed for children 6 to 23 months and 24 to 59 months of age.^{12,19,20} In each analysis, we adjusted for site, study year, insurance (public, private, or none), and enrollment setting (hospitalization, ED, or outpatient clinic). All statistical analyses were performed by using SAS 9.1 (SAS Institute, Cary, NC) and Stata 8.1 and 8.2 (Stata, College Station, TX).

RESULTS

Inpatient Surveillance

Study Population

From October 2000 through September 2004, 1468 children 6 to 59 months of age with ARI or fever were enrolled in inpatient surveillance studies across all 3 counties, and 81 (6%) had laboratory-confirmed influenza. More children with a history of asthma had a discharge diagnosis of asthma, bronchiolitis, or wheezing than did healthy children (16 of 19 children [84%] vs 18 of 61 children [30%]; $P < .001$). The median length of stay was 2 days for both children with asthma and healthy children ($P = .08$). Similar proportions of children with asthma and healthy children received supple-

TABLE 1 High-Risk Conditions for Enrolled Children 6 to 59 Months of Age According to Inpatient and Outpatient Setting

High-Risk Condition by Parental Report ^a	n (%)			
	Inpatient ^b		Outpatient ^c	
	All (n = 1468)	Influenza (n = 81)	All (n = 1432)	Influenza (n = 249)
Asthma	513 (35)	19 (23)	225 (16)	38 (15)
Heart disease	40 (3)	1 (1)	15 (1)	2 (<1)
Sickle cell anemia	20 (1)	0 (0)	7 (<1)	0 (0)
Cystic fibrosis	1 (<1)	0 (0)	1 (<1)	0 (0)
Diabetes mellitus	2 (<1)	0 (0)	0 (0)	0 (0)
Total	576 (39)	20 (25)	248 (17)	40 (16)
None	892 (61)	61 (75)	1184 (83)	209 (84)

Two influenza-positive children and 32 influenza-negative children were enrolled as outpatients and subsequently admitted. In this table, they are included in both the inpatient and outpatient groups.

^a Conditions were mutually exclusive, in the listed hierarchical order, and included in the child core questionnaire of the 2003 NHIS.

^b Two influenza-positive inpatients were classified as having none of these high-risk conditions but did have other underlying medical conditions (one child had cirrhosis and the other child had IgA nephropathy, ulcerative colitis, and spinal muscular atrophy).

^c Surveillance was conducted during the 13-week influenza seasons of 2002 to 2003 for 2 sites and 2003 to 2004 for all 3 sites.

mental oxygen (30% vs 31%; $P = .94$), and no child with asthma was admitted to the ICU.

Two influenza-positive children (1 with asthma) and 32 influenza-negative children were enrolled as outpatients and subsequently admitted; they contributed to both the inpatient and outpatient rates. Influenza-positive children were less likely than all enrolled children to have a history of asthma (19% vs 35%; $P = .03$) (Table 1). The proportions of influenza-positive children with asthma were similar for children 6 to 23 months and 24 to 59 months of age (22% vs 25%; $P = .79$).

Hospitalization Rates

From 2000 to 2004, the average annual influenza-attributable hospitalization rate for children 6 to 59 months of age with asthma was 1.0 case per 1000 children (range: 0.3–1.8 cases per 1000 children), compared with 0.4 case per 1000 children (range: 0.1–0.6 case per 1000 children) among healthy children (Fig 1A). The influenza-attributable hospitalization rates were higher among children with asthma for all years except 2001 to 2002. The average annual rates of influenza-attributable hospitalization for children with asthma and healthy children were 2.8 and 0.6 cases per 1000 children 6 to 23 months of age, respectively ($P < .05$), and 0.6 and 0.2 case per 1000 children 24 to 59 months of age ($P > .05$) (Fig 1B).

Outpatient Surveillance

Study Population

Among 1432 children 6 to 59 months of age enrolled in the clinics and EDs during the 13-week influenza seasons, 249 (17%) had laboratory-confirmed influenza infections (Table 1). A larger proportion of children with asthma had a discharge diagnosis of asthma, bronchiolitis, or wheezing, compared with healthy children (11 of 38 children [29%] vs 9 of 209 children [4%]; $P < .001$). Enrolled children had demographic characteristics similar to those of eligible children who were not enrolled.

Similar proportions of all enrolled children and influenza-positive children had a history of asthma or any high-risk condition. The proportions of influenza-positive children with asthma were similar for children 6 to 23 months and 24 to 59 months of age (12% vs 18%; $P = .20$).

Estimated Burden of Outpatient Visits

During the 2002 to 2003 season, influenza-attributable outpatient visit rates were similar for children with asthma and healthy children, that is, 60 vs 61 cases per 1000 children 6 to 23 months of age and 59 vs 62 cases per 1000 children 24 to 59 months of age (Fig 2). During the 2003 to 2004 season, influenza-attributable visit rates were significantly higher among children with asthma than among healthy children, that is, 316 vs 152 cases per 1000 children 6 to 23 months of age and 188 vs 102 cases per 1000 children 24 to 59 months of age ($P < .05$ for both).

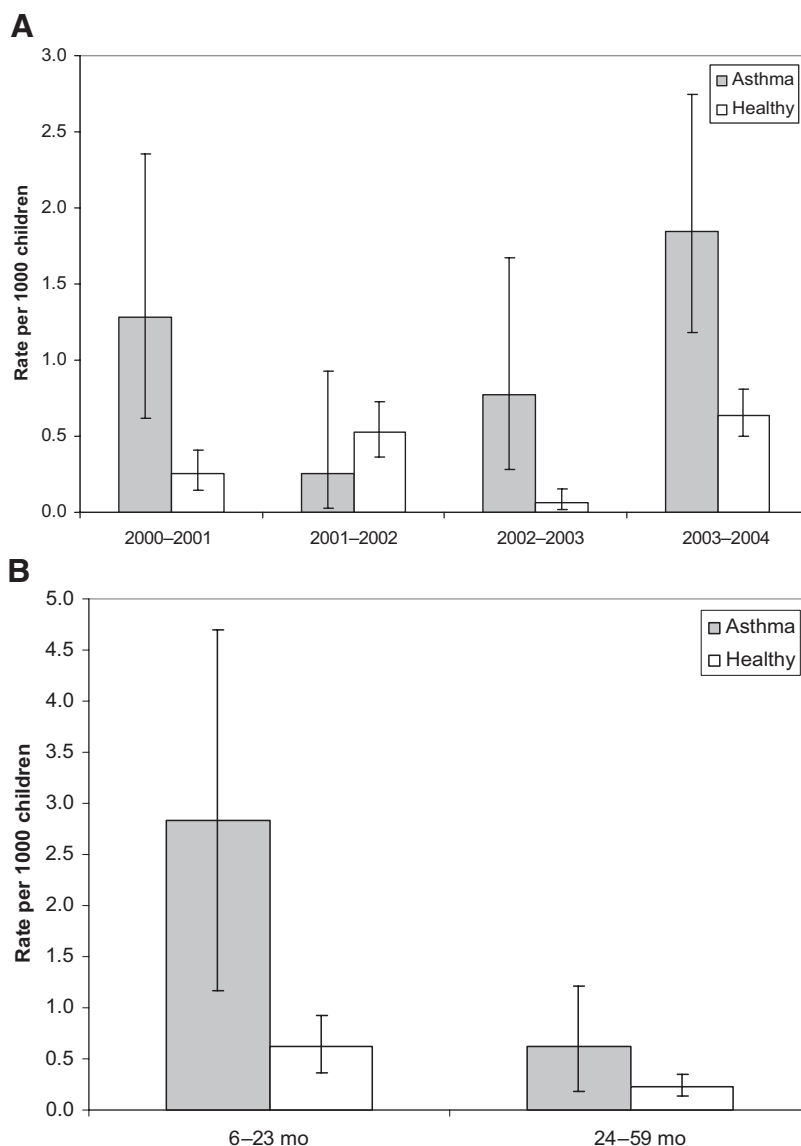
Influenza Vaccination Status

Parental reports of influenza vaccination status were evaluated for 1014 and 1035 influenza-negative children 6 to 59 months of age from inpatient and outpatient surveillance, respectively, in Nashville, Tennessee, and Rochester, New York. During all of the study years, more parents of children with asthma reported that their child had received the influenza vaccine (inpatient: 27%; outpatient: 27%), compared with parents of healthy children (inpatient: 12%; outpatient: 15%; $P < .001$ for both).

After adjustment for site, study year, insurance (private or public), and enrollment setting (inpatient, clinic, or ED), children with asthma had three- to fourfold greater odds of a parental report of influenza vaccination than did healthy children (Table 2). Other factors associated with increased influenza vaccinations, particularly for children 6 to 23 months of age, were being enrolled in 2003 to 2004, living in Rochester, New York (com-

FIGURE 1

A, Annual influenza-attributable hospitalization rates, with 95% CIs, for children with asthma and healthy children 6 to 59 months of age. Two influenza-positive children were excluded from the analysis of healthy children: one child had cirrhosis, and the other had IgA nephropathy, ulcerative colitis, and spinal muscular atrophy. B, Average influenza-attributable hospitalization rates for 2000–2004, with 95% CIs, for children with asthma and healthy children according to age group. Two influenza-positive children were excluded from the analysis of healthy children: one child had cirrhosis, and the other had IgA nephropathy, ulcerative colitis, and spinal muscular atrophy.



pared with the other 2 sites), and being seen in an outpatient clinic. Children were less likely to have a parental report of influenza vaccination if they were enrolled in the ED, were 6 to 23 months of age, or had public insurance.

DISCUSSION

In this study, children 6 to 59 months of age with asthma had approximately fourfold more influenza-attributable hospitalizations and twofold more influenza-attributable outpatient visits in 2003 to 2004 than did healthy children. These higher rates of influenza-attributable visits among children with asthma were observed despite their three- to fourfold greater odds of having a parental report of influenza vaccination, compared with healthy children. This study is the first, to our knowledge, to use prospective, laboratory-confirmed surveillance over multiple years to estimate rates of influenza-attributable visits for both children

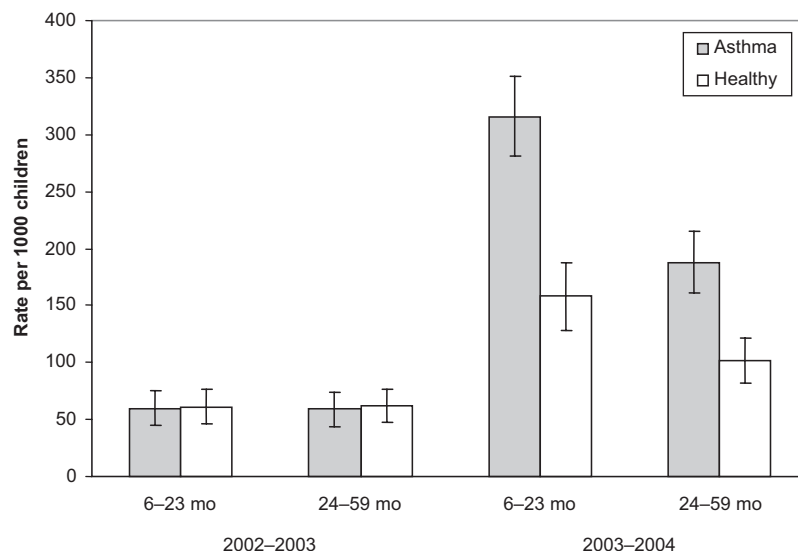
with asthma and healthy children, in inpatient and outpatient settings.

Our results are similar to earlier retrospective studies that showed that children with asthma and other underlying medical conditions have more influenza-attributable hospitalizations and outpatient visits than do healthy children.^{2,3,5} Glezen et al⁴ showed that respiratory viruses, including influenza, were commonly isolated among children with underlying conditions who were hospitalized with acute respiratory conditions.

There are several possible explanations for why children with asthma have more inpatient and outpatient visits. They may be more susceptible to influenza, more likely to have severe illness with influenza infections, more likely to seek medical care for ARI or fever, or more likely to be hospitalized than healthy children with the same clinical presentation, because of concern regarding asthma exacerbation.

FIGURE 2

Influenza-attributable outpatient visit rates, with 95% CIs, for children with asthma and healthy children according to influenza season.



Visit rates among children with asthma and healthy children varied according to study year and age group. Influenza-attributable hospitalization rates were higher among children with asthma than among healthy children 6 to 59 months of age in all study years except 2001 to 2002. When the average annual rates were compared according to age group, children with asthma 6 to 23 months of age had significantly more influenza-attributable hospitalizations than did healthy children, whereas the rates were not significantly different for children 24 to 59 months of age. These findings are understandable, because influenza-attributable hospitalization rates among all children vary from year to year and average annual rates were higher for children 6 to 23 months of

age than for those 24 to 59 months of age (0.9 vs 0.3 case per 1000 children).¹² Similarly, we noted higher rates of influenza-attributable outpatient visits among children with asthma than among healthy children in both age groups in 1 of 2 influenza seasons.

More parents of children with asthma reported that their children received the influenza vaccine than did parents of healthy children. This finding was expected, because influenza vaccine has been recommended for many years for children with asthma⁶ and was encouraged for all children 6 to 23 months of age in 2002 to 2003 and 2003 to 2004.¹⁹ Consistent with other reports, we found more influenza vaccinations in 2003 to 2004, a year with intense media coverage about the influenza

TABLE 2 Proportions of Influenza-Negative Children Who Were Vaccinated, According to Age Group, and Adjusted Odds Ratios of Influenza Vaccination

Characteristics	6-23 mo		24-59 mo	
	Vaccinated, n/N (%)	Adjusted Odds Ratio (95% CI)	Vaccinated, n/N (%)	Adjusted Odds Ratio (95% CI)
Children				
Healthy	151/999 (15)	Reference	49/512 (10)	Reference
Asthma	58/247 (23)	2.7 (1.8-4.0) ^a	85/291 (29)	3.7 (2.4-5.6) ^a
Study year				
2000-2001	22/177 (12)	Reference	16/97 (17)	Reference
2001-2002	17/204 (8)	0.7 (0.3-1.3)	15/102 (15)	1.0 (0.5-2.3)
2002-2003	67/483 (14)	1.4 (0.8-2.5)	52/328 (16)	1.8 (0.9-3.5)
2003-2004	103/382 (27)	3.5 (2.0-6.3) ^a	51/276 (18)	2.4 (1.2-4.8) ^a
Site				
Nashville, Tennessee	87/672 (13)	Reference	61/406 (15)	Reference
Rochester, New York	122/574 (21)	1.9 (1.4-2.7) ^a	73/397 (18)	1.5 (0.98-2.2)
Setting				
Hospitalization	99/646 (15)	Reference	82/368 (23)	Reference
ED	20/268 (7)	0.3 (0.1-0.5) ^a	12/163 (8)	0.2 (0.1-0.5) ^a
Outpatient clinic	90/332 (27)	1.5 (1.0-2.2) ^a	40/272 (15)	0.6 (0.4-1.1)
Insurance				
Private	99/505 (20)	Reference	63/389 (16)	Reference
Public	110/741 (15)	0.7 (0.5-0.9) ^a	71/448 (19)	1.0 (0.7-1.5)

The model for the adjusted odds ratio was stratified according to age group and included only the variables shown in this table.

^a Statistically significant $P < 0.05$.

season, than in previous years.^{21–24} Nevertheless, only 27% of children with asthma were vaccinated, similar to previous reports from multiple geographic areas.^{7–10,25} Following the pattern observed for all children,¹² the outpatient burden attributable to influenza was 50 to >300 times greater than the inpatient burden for children with asthma.

Several limitations of this study should be considered. Because influenza-attributable hospitalization rates were low among children 24 to 59 months of age, we had limited power to determine a difference in rates among children with asthma and healthy children in this older age group. In determining rates of influenza-attributable visits for children with asthma and healthy children, we used parental reports of asthma and other medical conditions, analogous to the NHIS method, to estimate the national prevalence of asthma among healthy children. These NHIS estimates of asthma and other medical conditions were not validated through medical chart review. The questionnaire for the NHIS survey includes most but not all of the high-risk conditions listed by the Advisory Committee on Immunization Practices. Only 2 influenza-positive children who would have been misclassified as healthy were discovered; they were excluded from the rate calculations. We also assumed that the prevalence of asthma in each surveillance county was the same as the national prevalence, although the prevalence of asthma has been shown to vary, particularly according to race/ethnicity.^{26–30} According to the 2000 US Census, the racial/ethnic distribution of the combined surveillance population was 65% white, 24% black, 6% Hispanic, and 5% other, and the national distribution was 58% white, 14% black, 19% Hispanic, and 9% other. Because our study population had a 10% greater representation of black patients, compared with the US population, our rates of asthma visits may be 5% to 10% higher than those expected nationally.¹⁶

Although some children who wheeze in the first 2 years of life have asthma, many do not. The inherent difficulties of accurately diagnosing asthma in young children might have affected our estimates, particularly among children 6 to 23 months of age. We used discharge diagnoses of asthma, bronchiolitis, or wheezing to estimate probable wheezing during the ARI or fever visit. However, children with asthma could have had asthma discharge diagnoses to indicate their history of asthma and not acute exacerbation, which would have exaggerated the differences between children with asthma and healthy children.

Vaccination status for children was determined through parental report. Although reports of influenza vaccination by adults are sensitive and specific, the reported sensitivity of parental reports of pediatric influenza vaccination (85%–88%) has been better than the specificity (66%–81%).^{31–34} However, the vaccination rates in our study were similar to published data and the 2002 to 2003 National Immunization Survey, which reported provider-verified vaccinations.^{7–10,14,35} We might have underestimated the influenza vaccination status of some children if they were enrolled early in the season

and received the vaccine after enrollment. We did not have data on complete vaccination versus partial vaccination, which provide differing levels of protection, and this might have affected our results.^{36,37} For this reason, we also did not measure vaccine effectiveness.

Although influenza remains an important cause of hospitalization and outpatient visits among all young children, the influenza-attributable burden is substantially greater among children with asthma than among healthy children. We found that the outpatient burden of influenza was at least 50-fold higher than the inpatient burden for both children with asthma and healthy children. To reduce this burden, targeted strategies to increase the influenza vaccination rates for both children with asthma and healthy children 6 to 59 months of age are needed.

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