Demographic Influences on Asthma Hospital Admission Rates in New York City*

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Surveillance reports describe an increase in asthma prevalence, and cite New York City as an area of excessive asthma mortality. To assess trends and the influence of geography, race, and ethnicity on hospital admission rates for asthma between 1989 and 1991, data of all admissions for asthma to New York City hospitals were reviewed. The average citywide annual hospital admission rate was 681 per 100,000 population, and the racial and ethnic distribution was 1,003 per 100,000 Hispanic patients, 810 per 100,000 for blacks, and 242 per 100,000 for whites ($p<0.0001$). Bronx and Manhattan had the highest admission rates, and contained a few zip codes with very high rates. In these zip codes, admission rates were consistently highest among Hispanics, followed by blacks and whites. New York City asthma admission rates increased 12.7 percent during the study. Very high admission rates among Hispanic patients and high rates in blacks, in specific geographic areas, are responsible for this trend. Targeted education and treatment programs could reduce hospital admissions and mortality in small geographic areas with high asthma morbidity. (Chest 1994; 106:447-51)

Asthma affects 9 to 12 million persons of all ages in the United States.1,2 Epidemiologic studies showed a decrease in asthma mortality from 1968 to 1977, followed by a steady increase to 1987, reaching a level even higher than in 1968.3,5 Surveillance reports also describe increases in asthma hospitalization and mortality rates beginning in 1979. Asthma hospitalizations for adults increased by approximately 50 percent from 1965 to 1983,2 and blacks were more than twice as likely to be hospitalized for asthma than whites.6 From 1980 through 1987, the death rate from asthma increased by 31 percent.6 Death rates were higher in older age groups, and they were consistently higher in blacks compared with whites.

Asthma morbidity and mortality is not distributed evenly across the United States. Weiss and Wagener5 carried out a state economic area geographic analysis and identified four areas of excessive asthma mortality: New York City, NY; Cook County, Ill; Maricopa County, Ariz; and Fresno, Calif. They suggested that the increase in asthma mortality in these areas alone may drive the US trend.

Between 1982 and 1986, asthma hospitalization and death rates in New York City varied greatly among geographic areas within the city, where blacks and Hispanics have higher proportions of hospital admissions compared with whites.7 This report examines recent trends in asthma admission rates in New York City to determine the influence of geography, race, and ethnicity on hospital admissions for asthma.

Methods

In 1980, the New York Statewide Planning and Research Cooperative System (SPARCS) began to collect information on each hospitalization in acute care hospitals in the state. The database includes demographic, diagnostic, epidemiologic, and financial information. We collected data on patients in New York City with the International Classification of Diseases-Ninth Revision Clinical Modification (ICD-9CM) diagnoses codes 493.00 to 493.91 for asthma from 1989 through 1991. Each hospital discharge record was examined for diagnosis, gender, age, race, ethnicity, and zip code of residence. Patients were assigned to an age group: younger than 35 years, 35 to 64 years, and 65 years and older. Data on the 65 or older age group were not analyzed because of possible diagnostic ambiguity between asthma and COPD in these patients.

Population data were obtained from the 1990 US Census (Caci Marketing Systems, Arlington, Va.). For each zip code in New York City, population data were sorted by gender, race, and ethnicity. Age-specific and gender-specific rates of hospital admissions for asthma per 100,000 persons for each study year were calculated using the method of Mausner and Bahn.8 The rate of asthma admission was determined for the entire city and for each of the 176 zip codes comprising its five boroughs (Bronx, Brooklyn, Manhattan, Queens, and Staten Island). All hospital admission rates were determined per 100,000 population. Fifteen zip codes had fewer than 10,000 persons, and were excluded from analysis.

The distribution of zip code admission rates per 100,000 persons was plotted, and the 25 percent of zip codes with the highest rates were studied for racial and ethnic distribution.

Key words: asthma; epidemiology; small area analysis

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CI=confidence interval; ICD=International Classification of Diseases; SAR=standardized admission rate.
The standardized admission rate (SAR) compares the actual number of admissions of a subpopulation in a small geographic area (zip code) with the expected number of admissions for that subpopulation. The expected number is calculated on the assumption that all subpopulations have equal risk of admission. Age-controlled SARs were calculated for blacks, whites, and Hispanics, using the following formula:  

\[ \text{SAR} = \frac{\text{Number of Observed Admissions}}{\text{Number of Expected Admissions}} \times 100. \]

Zip code subpopulations that contained fewer than 500 persons were excluded from SAR analysis to avoid spurious elevations due to small ethnic or racial subpopulations.

The SARs were evaluated by logistic regression analysis to obtain a measure of relative risk. This method was used to approximate a Poisson model for predicting asthma admissions.

RESULTS

Citywide Analysis

There were 149,076 asthma admissions in New York City during the study period of 1989 to 1991. The corresponding average annual admission rate was 681 per 100,000 population, compared with a nationwide rate of 185 per 100,000 in 1987. There was a 12.7 percent increase in New York City admissions between 1989 and 1991 (Table 1). Women had more hospital admissions than men in each year studied (p=0.01). During the study period, there was a 13 percent increase in admission rate for both age groups. Logistic regression analysis revealed a 22 percent greater risk of asthma admission in the 35- to 64-year-old age group for all years studied (adjusted RR: 1.22; 95 percent confidence interval [CI]: 1.19, 1.24; p<0.0001).

Average asthma admission rates per 100,000 population for racial and ethnic subpopulations revealed a rate of 1,003 for Hispanics, 810 for blacks, and 242 for whites. Multivariate analysis showed that the rate of asthma admission in 1990 was 4.91 times greater for Hispanics (95 percent CI: 4.76, 5.05; p<0.0001) and 4.16 times greater for blacks (95 percent CI: 4.04, 4.29; p<0.0001) compared with whites. Relative rates of asthma admission for Hispanics and blacks were also significantly higher in 1989 and 1991 than those for whites (p<0.0001).

Borough Analysis

When admission frequency was examined by borough, the Bronx had the highest average admission rate (95 percent CI: 1,022, 1,193; p<0.05) (Table 2). Gender analysis showed women consistently had higher admission rates than men, especially in the 35- to 64-year-old age group. Among men, the 0- to 34-year-old age group had slightly higher rates of asthma admission. Queens had the lowest average admission rate. However, Manhattan had the greatest percent increase between 1989 and 1991.

Small Area Analysis

The geographic distribution of asthma admission rates in New York City was positively skewed, such that a few small areas defined by zip codes had very high admission rates. Most zip codes had lower asthma admission rates, but still higher than the national average. Although the citywide asthma admission rate increased over the 3 years studied, the small area distribution remained unchanged. In 1989, the median rate per 100,000 population among zip codes was 405 and the interquartile limits at 25 percent and 75 percent were 231 and 643, respectively. In 1990, the median was 418 with interquartile limits of 236 at 25 percent and 748 at 75 percent, and in 1991, the

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distribution median was 407 with interquartile limits of 260 and 687. Seven zip codes, five in Manhattan (10026, 10029, 10030, 10035, and 10037) and two in the Bronx (10454 and 10456), consistently had very high admission rates. The highest asthma admission rates within zip codes were in the range of 2,000 to 2,750 per 100,000.

**SAR Analysis**

Citywide SAR analysis by race and ethnic subpopulation showed a disproportionate distribution of asthma admissions among the subgroups. During the study period, Hispanics had significantly higher SARs than blacks, and whites had the lowest SARs. The SARs of zip codes with high admission rates for asthma confirm this consistent pattern. For example, in 1991, the SAR in six of the seven zip codes was highest for Hispanics, followed by blacks and whites (Fig 1). Furthermore, between 1989 and 1991, the disparity among these three groups became more pronounced.

**DISCUSSION**

Over the past 25 years, there has been a reversal of the declining mortality from asthma. Although revision of the ICD coding was proposed as an explanation, Weiss and Wagener showed the increase actually began before the revision was implemented. This trend continued through the last decade. The ICD coding could have been responsible for an initial increase, but it does not explain a continuing rise.

The national hospital discharge rate for asthma increased from 174.6 per 100,000 in 1980 to 184.8 in 1987. Geographic analysis shows that asthma morbidity and mortality are not evenly distributed across the United States, and New York City is an area of excessive asthma mortality. Since asthma hospitalizations parallel asthma mortality, New York City would be expected to have a high asthma admission rate. This study shows a recent average asthma admission rate for New York City of 681 per 100,000 population, four times higher than the 1987 national average.

This analysis revealed a 13 percent increase in the hospital admission rate in both age groups during the study period, but risk of admission was greater in the 35- to 64-year-old age group. There was a significantly higher rate of asthma admissions in women than men in both age groups studied. This confirms the observations of Fulwood and Hurd of the Centers for Disease Control and parallels the higher asthma mortality rates seen in women.

The regional disparity within New York City is seen in larger areas defined by borough boundaries and in smaller areas defined by zip code boundaries. The Bronx consistently had the highest asthma admission rate, six times higher than the 1987 national rate. Manhattan had the highest percent increase, 28.7 percent, more than two times higher than the citywide increase.

Within each borough, small areas defined by zip code boundaries had significantly higher asthma admission rates than the citywide rate. In zip codes with high asthma admission rates, Hispanics consistently had the highest rates of admission, and blacks had higher admission rates than whites.

The recent increase in asthma morbidity and mortality in the United States appears to be driven by increases in specific geographic areas. Likewise,
when considering the positively skewed distribution of asthma admission rates in New York City, the admission rates of a few specific zip codes propel the increased citywide rate. Higher standard admission rates for Hispanics and blacks in these zip codes are responsible for sustaining the high admission rates.

Many explanations have been proposed to account for the uneven distribution of asthma admissions among racial and ethnic subpopulations. Asthma is usually treated in the outpatient setting. Greater use of ambulatory treatment by whites may explain their lower rate of hospitalization for asthma. According to the National Ambulatory Medical Survey, of 640 million outpatient visits in 1985, 6.5 million (1 percent) visits had asthma as the first-listed diagnosis. When asthma outpatient visits were examined by race and ethnicity, whites (28 per 1000 population) had more visits than blacks (24 per 1,000 population). Women had a higher rate of clinic visits, except in the 0- to 20-year-old age group. Whites may also have greater access to medical advice by telephone contact with private physicians.

Environmental factors are also implicated in the excess asthma admissions rates among minorities. Overcrowding, old building structures, the presence of vermin, cockroach antigens, dust mites, rodent dander, air pollution, and poorly ventilated living spaces all contribute to the conditions of the inner city. Bhat and colleagues describe pest infestation in 46 percent of the homes of patients attending clinics, compared with 12 percent of the homes of private patients in New York City.

Asthma among minority children has been linked with poverty. In Maryland, Wissow et al found that in the poorest black areas, the hospital discharge rate for asthma was more than ten times that of the more affluent white areas. In some small areas, such as East Harlem, there is a low median household income and a high asthma admission rate.

In this study, examination of the SARs of ethnic and racial subpopulations in the same zip code area shows disparate rates of asthma admissions. In the zip code areas with the highest asthma admission rates, rates among Hispanics were consistently higher than for among blacks, even though they are likely to have comparable economic and environmental profiles. Therefore, genetic factors may influence asthma admission rates. The familial nature of atopic disease has been verified by finding varying bronchial reactivity patterns in different family populations and by the interaction of atopy with HLA phenotypes.

In New York City, there is a relationship between asthma and alpha1-antitrypsin phenotypes among Puerto Ricans. Environmental factors, in turn, have a strong influence on the development of disease phenotypes.

One limitation of this study is that the validity of the data depends on the accuracy of each hospital’s reports to New York State Statewide Planning and Research Cooperative System and of the 1990 census in recording the population of New York City. We attempted to minimize extrapolation errors by studying the 3 years around the population census. Each record reflects one hospitalization, rather than an individual patient, so it was not possible to ascertain whether any patient was admitted to the hospital several times.

Another potential limitation of the study design is that some patients diagnosed as having asthma may, in fact, have COPD, especially in the older age group. However, patients aged 35 to 64 years can have asthma confirmed by pulmonary function testing with response to bronchodilator and corticosteroid treatment. We, therefore, chose to include this group in the analysis of asthma prevalence.

In summary, hospital admissions for asthma are markedly elevated within specific small geographic areas and among minority populations in New York City. This suggests a complex etiology of asthma, with genetic predisposition having a central role, and environmental and economic factors contributing to the disparity of distribution. Poor access to healthcare has been invoked to explain increasing asthma morbidity and mortality. While this may account for high admission rates in economically depressed zip codes, it does not explain the disproportionate admission rates between subpopulations within the same zip code. Primary care-based intervention strategies, including health education, regular personalized follow-up, and home care, can reduce the number of hospitalizations for asthma. These data support the distribution of limited healthcare resources to hospital and clinic systems serving specific populations within the small areas of greatest asthma admission activity.

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