Inner-City Asthma
The Epidemiology of an Emerging US Public Health Concern

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The burden of asthma on the US population is increasing. Between 1980 and 1987, US asthma prevalence increased 29%, asthma hospitalization rates increased 6%, and asthma mortality rates increased as well. These trends are not uniform across all age groups; and the most notable increases were for children and young adults. For children under 18 years old, US asthma hospitalization rates have demonstrated dramatic increases of 4.5% per annum during the 1980s. Rates for children increased during a time when total hospitalization rates for children decreased. In response to these disturbing epidemiologic trends, reductions in US asthma hospitalization rates have been targeted as a national objective, and a National Asthma Education Program (NAEP)—whose goal is to improve asthma care in the United States—has been established.

A key aspect to many of the recent epidemiologic studies of asthma has been the identification of subpopulations at higher risk for morbidity. Among the highest risk subpopulations are racial/ethnic minorities, who are both poor and reside in the certain urban environments. In this report, the epidemiologic studies that have defined the problem of asthma in the inner city will be examined, and directions in which new research and changes in clinical practice may positively impact upon this high risk population will be explored.

Geographic Variations in Asthma

The special problems of managing asthma in poor urban populations in the United States have been noted for decades. Only recently, however, have population-based studies begun to elucidate the magnitude of the risk that exists for the urban poor living in certain types of city neighborhoods.

Studies in the world literature have reported asthma in children and adolescents to be more prevalent in urban areas as compared to rural areas. This relationship of asthma prevalence to urban status, however, remains somewhat equivocal. For example, a study from South Australia found asthma prevalence among children ages 5 to 16 years higher in rural vs urban environments.

A study of geographic variation of all US asthma deaths in children and young adults identified 2 urban areas to have significantly high rates; for Cook County, Illinois, rates were twice New York City, three times that of the United States. In Cook County, asthma deaths were also disproportionately concentrated within the City of Chicago. More recent studies have suggested that the high rate of asthma mortality and hospitalization rates are not evenly distributed among urban neighborhoods; rather extremely high rates are concentrated in very small areas of high poverty, commonly termed "the inner city." Small area analyses of mortality in Chicago demonstrate that disproportionate numbers of deaths occurred within a very few inner-city neighborhoods. As seen in Figure 1, small area analyses of New York City asthma mortality rates demonstrate similar findings. Asthma mortality rates in 1 New York City neighborhood, East Harlem, were nearly 10 times higher than the average US rate. Disproportionately high mortality rates within the inner city appear to be closely correlated with high hospitalization rates.

Race/Ethnicity and Asthma

The inner city of the United States is inhabited by impoverished people who are disproportionately nonwhite. This demography raises questions as to whether, race/ethnicity or socioeconomic status (SES), represents the more prominent risk factor for asthma morbidity. Asthma prevalence varies among racial/ethnic groups in the United States.
Black persons, at any age, have been reported to have more asthma prevalence and higher hospitalization rates than non-Hispanic white persons. Asthma prevalence in Puerto Rican children living in the United States appears to be higher than in non-Hispanic white or black subjects. Mexican American children report lower rates.

It has been suggested that lung function may partially explain this racial/ethnic group variation in asthma prevalence. Mexican-American people have been reported to have higher respiratory flow rates than non-Hispanics and black subjects have lower rates than white or Mexican-American subjects. However, no differences in vital capacity were found among these 3 groups after adjusting for differences in lung size with sitting heights. Spirometry data from the second National Health and Nutrition Examination Survey demonstrated that black subjects had lower spirometric functions than white persons, but lung size again was found to be a factor as the difference all but disappeared when lung size was controlled for with forced vital capacity.

The effect of race/ethnicity on asthma prevalence remains uncertain. However, the magnitude of the effect is small as compared to its effect on measures of asthma morbidity such as hospitalization or mortality. The US asthma mortality rate in 1987 for black male subjects, ages 5 to 34 years, was 13.5 deaths per million population—nearly 5 times higher than the rate among white patients of both sexes. The 1987 hospitalization rate for black children, under 5 years, was nearly 3 times that of white children.

In Maryland, excess hospitalization rates for black children were observed at all ages and were nearly 5 times greater in black than in white adolescents, 15 to 19 years old. Similarly, data on both hospitalization and mortality rates from New York City demonstrate higher rates in black than in white subjects. The same data also demonstrate that hospitalization rates are 5 times higher and mortality rates 3 times higher for Hispanic than for white subjects.

Socioeconomic Status and Asthma

Much of the race/ethnic differences in US asthma morbidity, however, are greatly confounded by SES, with poverty directly correlated with greater morbidity. In fact, the literature is beginning to suggest a direct relationship between higher asthma prevalence, morbidity, and mortality, and lower SES as opposed to race/ethnicity.

Both the National Health and Nutrition Examination Survey, and the National Health Interview Survey have found asthma prevalence to be higher in poorer populations. The relative contributions of poverty and race/ethnicity to asthma prevalence, based on US population surveys have not been well defined. Among children in the 1981 National Health Interview Survey Child Health Supplement (NHIS-CHS), the black-white prevalence difference was eliminated after controlling for SES. On the other hand, the increased prevalence of asthma among black subjects reported in the second National Health and Nutrition Examination Survey (NHANES II), 1976 to 1980 for both children and adults, was not explained by SES factors.

As with race/ethnic factors, SES appears to have a modest effect on asthma prevalence and a large effect upon the variations in both hospitalization and mortality rates. The black-white differences in hospitalization rates for Maryland were markedly reduced when adjusted by census tract for income levels. Similar reductions were noted in race-specific geographic variations of hospitalization and mortality rates in both New York City and Chicago when the data were adjusted for household income. Together, these studies suggest that SES is predominant over race/ethnicity as a major risk factor which explains much of the disproportionate asthma morbidity seen in the inner city.

Problems of Inner-City Asthma and Known Risk Factors

Although there is mounting evidence that excessive asthma morbidity is highly correlated with poverty and inner-city residence, there are few studies that help elucidate the causal pathways through which these factors operate. Demonstrating a correlation between poverty, residence in the inner city, and asthma morbidity is not adequate to confirm a causal relationship. The first step in building confidence that a factor is causally related to morbidity requires identifying a pathway between the factor and the outcome. Once a pathway is described, research is needed to support or refute it. It is therefore important to examine how some of the currently suspected risk factors may lead to asthma morbidity in the unique or inner-city environment.

Social Demographics of the Inner City

The basis of our understanding of the unique environment of the inner city is based, primarily, in the sociodemographic and not the epidemiologic literature. In 1987, nearly 50% of black children and 42% of Hispanic children under 6 were poor vs 10% of white children. Forty-six % of all poor children in the United States lived in the central cities, and during the 12-year period from 1975 to 1987, the proportion of poor children living in areas of the central cities where 20% of the population or more is poor rose from 54 to 61%.

A disproportionate number of families in the inner city are headed by young, single, poorly educated women. In 1987, 30% of all children less than 6 lived with single mothers; the poverty rate among these children was 61%. Over one half of all poor young children lived with mothers who were separated, divorced, widowed, or never married. In a 1987 survey of poor Los Angeles families, 62% were headed by a single woman.

Host-Intrinsic Factors and Early Life Exposures Within the Inner City

Several risk factors have been associated with asthma. As examples, airway hyperresponsiveness and increased serum IgE levels, eczema, and allergen sensitization such as to house dust mite have been associated with increased likelihood of developing asthma. These host risk factors for asthma have not been thoroughly studied among inner-city children with asthma symptoms. Their relationship to asthma severity and the possible pathways through which these factors affect asthma morbidity need to be described.

Low birth weight has also been associated with asthma; perhaps because of its association with maternal cigarette smoking or with prematurity with its attendant risk of...
mechanical ventilation. While the proportion of infants born in 1988 weighing less than 2.5 kg (5.5 pounds) was about 5.6% for white infants, it was 13% for black infants and between 5.6 and 9.4% for Latino infants, depending on the country of origin of the mother. These higher rates of low birth weight may contribute to a proportion of the asthma morbidity of the inner-city population, though the causal pathways need further elucidation.

Though the role of breast-feeding in the prevention of atopy and asthma has not been well substantiated, it may have a prophylactic effect in children from highly atopic families. Breast-feeding may also help to ameliorate asthma by reducing the risk for respiratory infections, which, in turn, are known to trigger asthma attacks. The initiation of breast-feeding declined 13% between 1984 and 1989, while the rate of breast-feeding at 6 months declined 24% during the same period. These findings are most striking among black, young, poorly educated mothers enrolled in the women, infants and children supplemental food program, working outside the home, not living on the West Coast, and those with a low birth weight infant. The notably lower rate of breast-feeding exhibited among women living within the inner city may be correlated with increased asthma morbidity, however this has not been studied.

INNER-CITY IMPACT ON FAMILY AND SOCIAL ENVIRONMENT

The family is thought to play a central role in recognizing, managing, and preventing asthma symptoms. Further understanding of the family environment of the inner-city poor may suggest unique important factors which contribute or serve as pathways for the expression of asthma morbidity.

Family dysfunction has been related to asthma morbidity and mortality. The role of maladaptive patterns of family interaction on adherence to the medical regimen in asthma care has been documented, and Strunk et al. identified family dysfunction as an important risk factor for asthma mortality. Boxer et al. demonstrated a relationship between pediatric hospitalizations for asthma and breakdown of family functioning through the lack of symptom recognition and poor management of episodes. Frequent, serious family problems were noted among poor families surveyed by Wood et al., including physical and sexual abuse of the mother (41%), drug or alcohol abuse by the mate (39%), drug or alcohol abuse by the mother (21%), and mental illness in the mate (16%) or the mother (8%) in single parent families.

The inner-city family, often headed by young, single, poorly educated women, is at high risk for asthma mortality. Anderson et al. have suggested that the effect of social class on asthma morbidity in children was explained by its association with the mother's mental health. Parenting skills in these young mothers may not be highly developed. Single mothers receiving welfare may have weak social supports to help them through the stresses of caring for a chronically ill child. Social support has been shown to moderate stress and encourage improved coping with illness.

However, the impact of social support on asthma morbidity through the intervening variables of maternal mental health and family functioning has not been well studied. Also, the reported prevalence of mental health problems among children has been shown to exhibit an inverse relationship with SES. Residence in the inner city may amplify the effects of SES and mental health problems, and thus, disproportionately affect asthma management behavior.

Family finances are another important aspect of the family environment. Several studies highlight the extreme financial burden on poor families due to housing costs. In 1 study, poor families on average spent more than 60% of their total family income on rent each month, while 25% spent more than 80% of their monthly income on rent. These data hint at the disproportionate daily financial stresses on poor families which may affect their ability to cope with the demands of a family member with a chronic illness such as asthma.

CULTURAL ENVIRONMENT OF THE INNER CITY

Cultural beliefs affect a family's understanding of illness and symptoms as well as care seeking behavior. Patterns of utilization of health care services by Mexican-American people who live in the United States have been shown to relate primarily to degree of acculturation rather than social class. Similarly, cultural beliefs affect health providers' perceptions of patients, the way care is delivered, as well as expectations regarding patient adherence. Little is known about how cultural beliefs may affect asthma morbidity among inner-city minority families.

The high proportion of asthma morbidity among the Hispanic population suggests that language, specifically the lack of ability to speak English, may be an important risk factor for poor health status, as well as a barrier to care in its own right. In one survey, Hispanic subjects reported worse access to care than non-Hispanic white persons, and a higher proportion reported fair to poor health status. Hispanic subjects interviewed in Spanish reported even lower health status and worse access to care. Manson documented that when compared with Spanish speaking asthma patients whose physicians spoke their language, patients with non-Spanish speaking physicians were more likely to miss appointments and make emergency department visits and slightly more likely to omit medication.

PHYSICAL ENVIRONMENT OF THE INNER CITY AND ITS IMPACT ON ASTHMA

There are few studies which have directly examined the role of the unique physical environment of the inner city on asthma morbidity. This is perhaps surprising since, in general, the physical environment is thought to play an important role in the control of asthma.

Crowding, a characteristic of inner-city living, may increase susceptibility to respiratory infections. In one study of poor and middle class pediatric asthma patients in New York City, though there was no difference in reported mean family size, poorer patients resided in fewer rooms. Persistent abnormalities in pulmonary function and a tendency to increased asthma have been associated with respiratory syncytial virus infection, whose transmission is likely to be enhanced when susceptible children are crowded together.

In addition to crowding, there are many other unstudied aspects of the physical environment of the inner city which...
may contribute to asthma morbidity. For example, much of the housing stock of the inner city is deteriorating. Leaks and faulty functioning boilers may lead to increased exposures to indoor air pollution including any of the known irritant gases or to aeroallergens such as roach, mite, cat, and molds, that are believed to trigger asthma attacks.

Exposure to smoking has been shown to be a risk factor for asthma. Weitzman et al noted a relative odds ratio of 2:1 for asthma and 4:1 for using asthma medication among children 1 to 5 years of age if the mother smoked more than one half pack per day compared to mothers who did not smoke. This study showed no relationship between passive exposure to maternal smoke and hospitalizations for asthma, although the study sample may have been too small to detect a statistically significant difference. Data from the 1988 child health supplement to the National Health Interview Survey revealed significant differences in smoking exposure by family income, poverty, and total years of maternal education. Nearly twice as many children under 5 in families with the lowest income and a mother who had not completed high school had been exposed to smoking. Black children were more likely to be exposed to cigarette smoke than white children.

Increased crime, violence, noise pollution, and lack of safe transportation are a few of the many unique aspects of the physical environment of the inner city that have an important effect on day to day life. They also may have a critical impact on asthma management at home, through increased maternal and family distress, or in relation to the health care system, by posing barriers to seeking care. These factors have not been studied.

**Health Care Delivery System within the Inner City**

The Expert Panel Report of the National Asthma Education Program notes that asthma is a chronic illness requiring continuous medical care to control symptoms and prevent acute exacerbations. However, access to adequate care remains fundamentally important to achieving the care described in the NAEP guidelines.

In 1985, among children under 6, 30% of the poor and 32% of the near poor were without health insurance, while only 13% of those families who were more than 150% above the poverty line were uninsured. These poor, uninsured children made 38% fewer visits to a physician than those with insurance. Poor children are also twice as likely to report no regular source of pediatric care and are far more likely to receive their care from overburdened hospital outpatient and emergency departments rather than from individual physicians.

With the advent of Medicaid, access to medical care for poor children improved considerably. However, many families eligible for Medicaid are not covered, and a growing number of uninsured families do not qualify for Medicaid because their income is above the Medicaid eligibility cutoff (133 to 185% above the poverty line). Between 1979 and 1987, the percentage of asthma hospitalizations for children reporting either Medicaid and self-pay increased. Moreover, while Medicaid overcame an important barrier to care for previously uninsured children, it has established its own less easily measured barriers such as completing and processing forms, waiting in lines, and lack of access to office-based physicians. In Maryland, asthma hospitalization rates for children with Medicaid were both higher and slightly more likely to be emergent admissions. These reports suggest, that for asthma, Medicaid may not be providing an adequate access to good quality health care.

Understanding the differences in the type and quality of health care systems available in the inner city will be critical to adapting the NAEP guidelines to care in this high risk population. In a survey of children attending Baltimore public schools, 40% of whom were receiving public assistance, Mak et al noted that 52% of first graders and 45% of sixth graders with asthma reported obtaining their asthma care from the emergency department. In New York City, 42% of physician visits made by poor and 33% by the near poor are made to hospital outpatient departments, while only 14% of visits by the nonpoor are made to those settings. Moreover, segments of the population making 60% or more of their physician visits to hospital based sites include near-poor black children aged 5 to 17 and nonpoor Hispanic children aged 5 to 17.

Much of the research on access to care has focused on whether respondents report a regular source of ambulatory care. Yet, differences in the source of care have received little attention but may impact in important ways asthma morbidity. Some types of health care structures may be more or less conducive to providing continuity of provider. There may be barriers to entry into the continuity component of hospital based ambulatory care systems, and there may be important differences in the technical care provided as well as in physician attitudes which affect patient adherence to medical regimens, as well as clinical outcomes, including hospitalization practices.

**Therapeutic Adherence: A Common Pathway to Good Outcomes**

Adherence may be one of the most important pathway variables through which many risk factors affect asthma morbidity. Asthma knowledge, skills, and management behavior impact on adherence. In turn, these variables are affected by mental health, family functioning, social support, stress, and personal health behaviors such as smoking, and drug and alcohol abuse.

Access to good quality health care is also likely to impact on asthma morbidity through adherence. It is easy to imagine how patients without access to care will have no health care plan to follow. Variations in the quality of care may also impact on adherence, which, in turn, may be associated with variations in outcomes. Good quality long-term continuous care is believed to result in better adherence with long-term medication regimens and other preventive asthma management plans. However, the inner city environment is likely to compromise many of these health care delivery factors that are required prerequisites for adherence.

**Conclusions**

We have presented some findings from the epidemiologic literature that document an emerging problem of excess asthma morbidity within inner-city populations. In doing so, areas for further investigation present themselves. Future research must attempt to provide causal links between risk factors that are associated with poverty and living in the
inner city and asthma morbidity. Special attention must be paid to factors that both account for a considerable proportion of the morbidity and are susceptible to intervention. Although several educational intervention programs have demonstrated success in this high risk population, the success has been limited and requires a relatively substantial investment of resources.

In addition to educational efforts, new clinical interventions will have to be explored and developed, based on our knowledge of how to intercede early in this chronic illness in order to begin to prevent asthma morbidity. Also, it seems clear that future efforts should examine the relative effectiveness of community- and health-system-based interventions. The new efforts undertaken by both the National Cooperative Inner-City Asthma Study of the National Institute of Allergy and Infectious Disease, and the Control of Asthma among black and Hispanic Children Program initiated by the National Heart, Lung, and Blood Institute are solid first steps to developing the much needed programs to improve this emerging public health problem.

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