

## **The Multi-Dimensional Effects of Poverty on Childhood Asthma**

The South Bronx, one of New York City's most impoverished regions, is home to daily gang violence, dozens of garbage, sewage, and medical waste incinerators, and the nation's highest asthma rates. It is also home to Isaiah, a garrulous, optimistic eight year-old boy. Isaiah and his mother live alone in a substandard public housing complex. His positive disposition hides that he has endured far more trials than most eight year-old children in affluent Riverdale, a Bronx town only miles away. He watched as his mother struggled with a cocaine addiction and as his father was forced to move upstate, fleeing debts to heroin dealers. He copes well with his disadvantaged environment, but suffers almost daily with attacks of wheezing brought on by fits of asthma. He inhales medication to help ease his breathing, but there are better drugs on the market that his doctor has not prescribed him. On many days, fear of the disease prevents Isaiah from playing with his friends and often causes him to miss school. Asthma is one more obstacle in an already disadvantaged and difficult childhood (Kozol, 2000). Isaiah's story is not uncommon. Asthma rates and severities are significantly higher for children of impoverished environments than for more advantaged children, a disparity that is steadily widening.

### **Introduction**

Asthma is a life-threatening, yet manageable disease affecting increasing numbers of children in developed nations, a growth in prevalence that is especially evident in impoverished populations. In addition to increased disease incidence, the children of this group are at increased risk for developing more severe outcomes as a result of the disease than other more advantaged children.

Poverty is not easily defined as a measure of income, but instead is a combination of a several factors. Familial income, size, debt, and asset worth all contribute to economic measurements. Housing and access to healthcare also contribute to classification as impoverished. Similarly, prevalence and severity of asthma among the impoverished is not the result of one definitive factor. A combination of environmental, biological, and psychosocial factors contributes to an increase in both disease prevalence and severity. A greater understanding of these risk factors and their relative contributions to the disease can help create a multifaceted approach to treating the disease and reducing poverty-related disparities.

### Asthma Definition

Asthma is a chronic condition characterized by inflammation of the bronchial airways. This leads to increased mucus production, mucosal swelling, and muscle contraction, ultimately restricting breathing (American Lung Association, 2004). Inflammation is most commonly caused by allergic reactions to airborne contaminants, named allergens. In children with sensitivities, these allergens elicit immune reactions, causing the body to produce an antibody responsible for bronchial inflammation (NIH, 2005). Some viral respiratory infections and airborne irritants can also cause this inflammation through similar mechanisms (American Lung Association, 2004).

### Consequences

Symptom expression elicited from asthmatic attacks can lead to a variety of serious consequences, impairing children's short- and long-term well-being. These effects can be both biological, altering their physical world, and psychological, altering their mental one.

### *Biological*

Asthma is a manageable disease; however, if improperly treated it can yield devastating consequences. Every year, asthma contributes to over 5,000 deaths in the United States alone, a mortality rate that has been steadily increasing over the past several decades. Between 1975 and 1979, 8.2 of every 100,000 American asthmatics died annually from the disease. Between 1993 and 1995, this figure more than doubled to 17.9. In addition, asthma is responsible for over 400,000 hospitalizations annually, at least 150,000 of which are pediatric (NIH, 2005). Restricted breathing and risk for these severe physical consequences impact children's participation in daily activities.

Asthmatic children often choose to or are required to avoid physical activities that often trigger disease exacerbation. Symptoms cause them to be absent from school significantly more often than healthy children (Gillapsy et al, 2002).

### *Psychosocial*

Over time, asthma and its effects can lead to the development of emotional, psychological, and academic impairment. Anticipation of unexpected, debilitating attacks creates feelings of uncertainty and lack of control. Attacks that limit ordinary play activity with peers and the ability to attend school regularly result in a sense of social isolation. Together these factors harm children's development. Asthmatic children are at increased risk for a wide range of psychological impairments, including adjustment problems, depression, behavioral and social-related problems, social incompetence, low self-esteem, and low academic achievement (Gillaspys et al, 2002; Mitchell & Murdock, 2002; Mitchell et al, 2004). Any of the psychological problems can ultimately affect adult societal participation.

### Development Risk Factors

Susceptibility to developing asthma is linked to several separate categories of risk factors: environmental, biological, and psychosocial. Each of these factors correlates with the development asthma and/or the exacerbation of its symptoms.

#### *Environmental*

Living conditions associated with impoverishment are often also linked with increased likelihood of developing asthma. Environmental exposure to indoor and outdoor contaminants often linked with inferior housing significantly impact asthma aggravation. Many allergens contributing to asthma development can be found within the home. These include dust mites, pet allergens, from dander of dogs or cats, and pest allergens, caused by the presence of rats, mice, or cockroaches (Leaderer et al, 2002; Matsui et al, 2004; Lanphear et al, 2005; Perry et al, 2003). Environmental tobacco smoke also contributes to the development or exacerbation of childhood asthma. In particular, maternal smoking, both prenatal and postnatal, is strongly linked with asthma onset (Klennert et al, 2002; Lanphear et al, 2004).

Other environmental allergens, such as air pollution, are derived from sources outside the home. Chronic exposure to air pollutants can negatively impact lung development and function, contributing to the onset or exacerbation of respiratory diseases like asthma. A number of events ranging from volcanic eruptions to industrial steel millwork can create such pollutants (Peden, 2005). Motorized traffic is a particularly major source, emitting large amounts of nitrogen dioxide and particulate matter into atmospheric air. This nitrogen dioxide can then react with sunlight to form ozone. One study of children in suburban New York showed that prevalence of

childhood asthma may be related to proximity to state routes and their traffic volumes (Lin et al, 2002). Additional studies show that exposure to increased levels of nitrogen dioxide and ozone correlates with increased likelihood of developing asthma as well as exacerbation of existing asthma. In addition, diesel exhaust and environmental tobacco smoke exposure affect the antibody responsible for brachial inflammation associated with sensitivity to allergens (Peden, 2005).

Outdoor environmental risk factors do not inherently discriminate between children of different income levels; diesel exhaust does not consciously target the poor over the rich. However, some of these environmental components are more likely to impact the disadvantaged than the advantaged. For example, the South Bronx, an impoverished region of New York, is home to well over forty garbage treatment and recycling facilities, each of which generates and emits smoke and fumes into the environment. While it is unknown whether these specific chemicals play a role in asthma onset, the diesel fumes emitted by the countless trucks visiting these sites do (Kozol, 2000). More affluent regions are often able to prevent such incinerators from entering their communities, because of their inhabitants' greater political influence. Few government officials would risk campaign support or friendship of the wealthy for a garbage incinerator. Environmental factors affect disadvantaged communities more powerfully because of their limited political and monetary influence.

### *Biological*

Not every child exposed to identical allergens at identical levels is equally affected by asthma. Numerous factors may contribute to vulnerability to environmental risk factors. The most significant of these is maternal inheritance. An asthmatic mother is much more likely to have an asthmatic child than a mother without asthma. Smaller

lungs and brachial airways, the result of genetic inheritance or pollutant-induced stunted development, also influence asthma development (Federico et al, 2003; Peden, 2005). Several specific genes have been implicated to influencing resistance to asthma. The *GST* gene, for example, is linked to lung development. Children that do not express the gene are more likely to develop the disease, and with increased severity, than those who do express it. *GST* may also influence children's resistance to environmental pollutants; those that express the gene are less susceptible to the effects of prenatal maternal tobacco smoke exposure and to diesel exhaust (Peden, 2005).

The biological risk factors associated with susceptibility to asthma are not solely genetic. Studies indicate that birth weight, which impacts physical development, correlates with the likelihood of developing asthma during childhood. One such investigation, a national longitudinal analysis of very young children, found that children with low birth weights were twice as likely and those with very low birth weights were four times as likely to develop asthma than those of healthy birth weight (Brooks et al, 2001)<sup>1</sup>. Birth weight can result from inadequate maternal nutrition and prenatal exposure to environmental tobacco smoke or alcohol (March of Dimes, 2005).

Asthma onset is not strongly linked with childhood diet; however, several specific nutrients and vitamins may contribute to either asthma prevention or exacerbation. Antioxidants found in some foods may prevent ozone from affecting lungs, suggesting that high antioxidant ingestion can help prevent asthma onset. Similarly, vitamin E and C intake may prevent environmental sulfur dioxide from harming lung tissue following ozone exposure (Peden, 2005). In addition, certain foods are associated with aggravation of asthma symptoms. Some meat preservatives and some drinks that contain sulfur

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<sup>1</sup> Healthy birth weight is defined as 2500 grams or greater, low birth weight is 1500-2499 grams, and very low birth weight is less than 1500 grams.

dioxide or benzoic acid derivatives, such as orange drink, wine, and beer, may contribute to the onset of such symptoms (Land & Storr, 1987).

### *Psychosocial*

Psychological stresses elicits a fight-or-flight bodily reaction resembling that of physical threat. In an attempt to maximize energy resources available for eliminating a threat, the body depresses less immediately necessary functions, including immune system activity. Therefore, it is not surprising that increased exposure to childhood stressors correlates with increased probability of developing diseases such as asthma (Federico & Liu, 2003). Young maternal age, single parenthood, and impaired parental mental and cognitive health are all linked to development of the disease (Klennert et al, 2002). Children stressed by safety threats, poverty, and other concerns are also at greater risk for asthma (Federico and Lin, 2003).

### *Inter-relatedness*

It is important to recognize that each of these risk factors correlates to the development of asthma; however, none has been shown as a definitive cause. Many of these factors are likely linked to the disease through a third variable. The relatedness and common coexistence of these factors limit investigators' ability to isolate one as a determinant of asthma onset. Homes with high levels of rat allergen often also have high levels of mouse and cockroach allergen and have heavily polluted air. Socioeconomic class is tightly linked with race, psychosocial stresses, the presence of specific in-home allergens, and the probability of maternal tobacco smoke. Prenatal exposure to maternal tobacco smoke is linked with premature births and low birth weight. The

interconnections are not limited to the given examples and likely significantly affect studies' findings.

### Asthma Prevalence

It is uncertain to what degree each of these factors contributes to asthma onset. It is also not entirely certain how these risk factors interrelate to form trends of asthma prevalence in developing communities. Asthma prevalence is highest among urban, poor, African American youth and lowest among nonurban, nonpoor, Caucasian youth; however, it is unknown whether geographic, income, or racial/ethnic differences cause this difference.

### *Geography*

Some suggest that asthma susceptibility is dictated not by racial or income differences, but by residential location. One such study compared a national sample of parentally reported rates of asthma of urban and nonurban<sup>2</sup> children of different races<sup>3</sup> and different income levels<sup>4</sup>. After controlling for other possible contributing factors, including maternal education and parental smoking, investigators determined that both urban African American and Caucasian children are more likely to have asthma than nonurban Caucasian children, while nonurban African American children were not significantly more likely than nonurban Caucasian children to develop asthma. Similarly, more urban poor and nonpoor had childhood asthma than nonurban nonpoor, while nonurban poor were not at an increased risk. This may suggest that asthma prevalence is

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<sup>2</sup> Here, "urban" is the main city of a metropolis while "nonurban" is any another surrounding city.

<sup>3</sup> Race categories in this study are "black," "white," and "other."

<sup>4</sup> Income levels in this study are defined as poor (below the poverty line) and nonpoor (above the poverty line).



not related to race or income, but rather to residence within an urban city center (Aligne et al, 2000). An unknown group of risk factors may coexist in urban settings that contribute to vulnerability to pediatric asthma.

### *Race and Ethnicity*

Others suggest that asthma prevalence is related to race and ethnicity rather than location or income. One such study found that 3.0% of Caucasian children between 6 months and 11 years old had been diagnosed with asthma compared with 7.2% of African American children of the same age range. Another similar study found that of 7 to 14 years old children, 4.8% of Caucasians are asthmatic while 6.7% of African Americans are. The racial disparity remained significant each after removal of confounding variables, such as income and location, showing a strong racial division in pediatric asthma prevalence (Eggleston, 2000).

One study found clear distinctions between ethnically diverse families. Investigators compared asthma ecology between only low-income, Medicaid-eligible children affiliated with, and presumably residents near, metropolitan Denver hospitals. By comparing data from Caucasian, African American, High-Acculturated Hispanic, and Low-Acculturated Hispanic children, they found that a number of risk factors – including, but not limited to, parental marital status, maternal asthma status, prenatal smoke exposure, environmental allergens, and familial stress level – were significantly different across the four groups. The subjects' similar income levels and regions of residence indicate that these biological and psychosocial risk factors are independent of these other variables, indicating a possible racial difference. The significant differences between highly and lowly acculturated Hispanics indicate that such a differences may not be solely the result of biological variability. Varying exposure to environmental allergens

and stressors may contribute to racial and ethnic prevalence differences (Klinnert et al, 2002).

### *Income*

Increased prevalence of childhood asthma also correlates with familial poverty, most often calculated as degree of familial income or a derivative calculation. One study of children in Sheffield, England found that progressively higher rates of deprivation<sup>5</sup> associated with progressively higher accounts of asthma and asthma-related symptoms. Though the investigators failed to address racial variability within the deprivation quintiles, findings suggest that degree of poverty is nearly linearly related to probability of asthma development (Ng Man Kwong et al, 2002). This introduces the possibility that studies limiting the poverty variable to poor or nonpoor are inadequately dividing the population and consequently may be overlooking significant effects.

### *Conclusions*

There are a number of variables further complicating the understanding of prevalence of childhood asthma between different subsets of the population. Each study employs a distinct method of surveying and analyzing data, differing in subject age range, method of data collection, income level denoting poverty, and criteria for asthma classification. In addition, a number of studies have failed to find any significant geographic, racial, or income differences in asthma prevalence following elimination of confounding variables (Akinbami et al, 2002). Because it is theoretically and physically difficult to isolate these variables, it may be necessary to think of them jointly when

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<sup>5</sup> In this study, "deprivation" is a quantitative calculation based on asset value, employment, and household size.

considering methods of reducing prevalence. Programs aim to lessen asthma in all at-risk populations rather than concentrating on a specific regional, racial, or socioeconomic subgroup.

### Asthma Severity and Resilience

While there is considerable evidence that asthma prevalence is influenced by racial and poverty factors, there is even more definitive agreement that asthmatic children in disadvantaged and minority groups are at significantly increased risk for disease severity than more advantaged, Caucasian asthmatic children. Asthma disproportionately affects the inner city, a region characterized by its large population of impoverished and minority residents. Severity, measured by morbidity and mortality rates are significantly higher for asthmatics in inner city communities than those of other areas (LeNoir, 1999).

There are significant racial discrepancies in severity of asthma, with African American and Hispanic American children suffering from substantially higher morbidity and mortality rates than their Caucasian peers. Inner city children of these minority groups are two to six times more likely to die from asthma than inner city Caucasians (LeNoir, 1999). Minorities are also significantly more likely to seek emergency care and ultimate hospitalization, a trend that is seemingly widening. Nationally, African Americans are hospitalized for asthma three times as often as Caucasians (LeNoir, 1999). One study of an urban South Carolina hospital found that over a twenty-year period, the proportion of asthma-related hospitalizations for African Americans increased by twenty-fold while those of Caucasians increased only three-fold. This is a trend mirrored by several other studies examining hospitalization patterns in several different cities (Crater et al, 2001).

Degree and frequency of asthma-induced activity limitation are also racially differentiated. Asthmatic African American children are 53% more likely to be limited by their condition than asthmatic Caucasian children. Similarly, 33.2% of children of families earning below the poverty line are limited by asthma, compared with only 20.8% of children above the poverty line<sup>6</sup>. Controlling for race and income, poor African American children are significantly more likely to be limited by the disease than nonpoor Caucasian children (Akinbami et al, 2002). In a population of children in England, increasing deprivation<sup>7</sup> is linearly correlated with increasing frequency and severity of asthmatic symptoms (Ng Man Kwong et al, 2002).

In addition to differing along racial lines, childhood asthma severity may differ along ethnic and class lines. In one study, lowly acculturated Hispanic families were much more likely to utilize emergency services than highly acculturated Hispanics, yet lowly acculturated Hispanics reported significantly lower disease severities. This suggests that other variables influence racial disparities in asthma severity. One possible variable is degree of child and familial stresses, which lowly acculturated Hispanics reported at far lower levels than highly acculturated (Klinnert et al, 2003).

Asthma's psychological effects are also more severe for the impoverished than for the more advantaged. Asthmatic children in general are typically at greater risk than healthy children for ultimately developing psychological problems. Likewise, children of low socioeconomic status are more likely to develop psychosocial problems, including academic deficiency, emotional impairment, and general psychological distress, than their more wealthy counterparts. A recent study discovered an increased risk for

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<sup>6</sup> Data in this study was collected through parental surveys. Activity limitation was the degree to which children under 5 years were restricted from "ordinary play" and children over 5 years were absent from school due to asthma.

<sup>7</sup> In this study, deprivation is a quantitative calculation based on asset value, employment, and household size.

psychological distress among youth of low socioeconomic status with asthma compared to their healthy peers of equal income. Overall, this suggests that impoverished asthmatic children have more severe psychosocial outcomes than more advantaged asthmatic children (Gillapsy et al, 2002).

### Causes of Severity Disparity

As with asthma prevalence, asthma severity is likely caused by multiple risk factors. Exacerbation of asthma and its symptoms is caused by a combination of variables, which include psychosocial, healthcare, pharmaceutical, and environmental components.

### *Psychosocial*

There is little question that parental vigilance and behavior are strongly correlated with asthma severity. An attentive, available parent is more likely to recognize symptoms of her child's asthma, prompting her to seek treatment earlier and more often than an absent or preoccupied parent. She would also be more likely to strictly follow a treatment program, maximizing the possibility of correct asthma management. It intuitively follows that family situation and structure are intricately involved in severity of childhood asthma. Single parenthood, for example, is strongly correlated with increased hospitalization for childhood asthma (Klennert et al, 2003). Familial and societal stressors, or children's perception of such stressors, are also associated with asthma severity. Exposure to violence or threat of assault is linked to asthma aggravation, suggesting that children living in potentially dangerous environments, such as inner cities, may be at increased risk for severe asthma (Federico & Lin, 2003). Caregiver anxiety is also strongly associated with childhood asthma severity. This could indicate either that

children's perception of familial stress may exacerbate asthmatic symptoms or that parents become more anxious in response to their children's severe asthma (Klennert et al, 2003).

### *Biological*

There is evidence that some of the racial disparity in severity may be due to biological differences. One study examining pharmacological responses found that African American asthmatic subjects required greater concentrations of medication to suppress immune system reaction to treatment, suggesting that this racial group is biologically less responsive to this particular treatment (Federico et al, 2005).

In addition, asthma severity has been linked with childhood obesity. Otherwise healthy obese children have been shown to have bronchospasms in response to exercise. One study directly examined obesity's link with asthma severity tested inner-city children, finding that obese asthmatics use more medication, show more asthma symptoms, and seek more frequent emergency care than non-obese children with asthma. This possible link between obesity and asthma severity suggests that an adequate healthcare plan would also work to reduce pediatric obesity (Belamarich et al, 2000). The direction of a relationship between obesity and asthma severity is uncertain. Obesity may increase asthma severity. It is also possible, however, that children with more severe asthma are less able to participate in physical activities, which often exacerbate symptoms, leading to an increased likelihood of becoming obese.

### *Healthcare*

One of the most important contributing factors of increased asthma severity is inadequate healthcare access. The most successful management plan involves

knowledgeable and aware physicians, regular health assessment follow-ups, and complete patient and family education. Deterioration of any of these elements significantly impairs the quality of treatment and the likelihood of successful outcomes.

Asthma patients in urban, especially low-income inner city, communities use significantly more emergency care and significantly less primary physician care than those in more advantaged environments. One New York City study found that 75.4% of children in low-income areas typically receive their short-term asthma care directly from the emergency room. The drawbacks for this method of primary care are not limited to the inherent increase in financial cost. Parents without a primary care physician may be more likely to delay treatment until symptom progression is severe and threatening enough to merit emergency attention. A lack of consistent care also limits physicians' ability to correctly diagnose and consequently adequately treat asthmatic children. If a doctor has no documentation of medical history, he is likely to treat the acute symptoms rather than the overall disease. In addition, lack of consistent care limits parents' likelihood of seeking proper follow-up appointments, in which a good physician would monitor disease progression, provide appropriate pharmacological consistency or variation, and explain and promote lifestyle changes that would further optimal disease management (LeNoir, 1999)

There is evidence that some low-income children may not be receiving adequate care, even when able to access a consistent primary care physician. One study of a health clinic in the South Bronx found that in general, physicians underestimated children's asthma severity, resulting in inappropriate treatment. This has two possible implications for an understanding of asthma severity of the impoverished. First, physicians that misdiagnose and provide inadequate treatment may cause symptom exacerbation and greater ultimate severity. Second, if such an underestimation is universal in

impoverished communities, there may be an even greater severity discrepancy between advantaged and disadvantaged children than currently recognized (Braganza et al, 2003).

### *Inadequate Drug Management*

Limited access to proper medications contributes to impoverished children's increased asthma severity. Studies show that children in inner-city neighborhoods are significantly more likely than those of other regions to substitute typically recommended medications with ineffective and dangerous over-the-counter medications. This inadequate pharmacological treatment may result from a lack of both consistent, effective healthcare and of monetary means of obtaining ideal medications. However, treatment behavior may not be caused by only financial and geographical limitations. One study of 464 African American and 1,609 Caucasian patients using the same managed care plans with equal frequency were treated differently by physicians and consequently had unique disease progressions and outcomes. African Americans were less likely to receive correct medication or to be referred to specialists as Caucasians. Ultimately, these less effectively treated patients were more likely to visit the emergency room and be hospitalized than Caucasian patients. Though these findings may result from an unknown third variable, they suggest that patients of different races receive varying asthma treatments (LeNoir, 1999).

### *Control of Factors*

A number of environmental risk factors for development and onset of childhood asthma are also associated with increased risk of severity. Exposure to rat, dust, and cockroach allergen, environmental tobacco smoke, and atmospheric pollutants are all associated with asthmatic symptom expression and exacerbation (LeNoir, 1999; Klinnert



et al, 2003; Perry et al, 2003). Disadvantaged populations lacking consistent adequate healthcare may not be informed about the pollutants that aggravate asthma symptoms. Many of those that have this knowledge may lack the power or resources to exit or alter their environments. This disparity can be influenced by greater creation and enforcement of public policies requiring housing improvements and reductions in emissions of environmental pollutants. Excellent, influential healthcare providers can also work to improve living conditions for impoverished patients.

### *Problems with Analysis*

It should be noted that method of investigation could greatly affect study results and their general applicability. Many determine asthma population amongst large populations using parental reports, a widely variable and subjective technique, as parents in one racial or income subgroup may tend to report greater asthma severity than parents of another subgroup, regardless of genuine variation. Others examine quantity of emergency department visits or hospitalizations to determine asthma severity, a measure that may not directly measure severity itself. One population may be more likely than another to use hospitals as a form of primary care, meaning that greater visits could be linked more closely with access to healthcare than with disease severity. In contrast a subgroup may be more vigilant than another, accessing emergency departments more quickly for lesser disease severity. Caregiver reports of severity are not directly related with number of hospitalizations, though they are correlated with emergency departments' analyses of childhood illness severity, suggesting that surveys may be more effective at measuring asthma severity than data on hospitalization quantities (Klennert et al, 2003). The applicability of hospitalization and emergency department utilization as a direct measure of asthma severity is not entirely known; however, regardless of the relationship

between hospital use and disease exacerbation, significant disparities have important significance. Subgroups' different patterns of primary care use may indicate disparities in availability in education of the best means of asthma treatment.

### Solutions

A number of studies examine specific programs' and organizations' efficacies at reducing asthma severity in disadvantaged children populations. Each of these seeks to reduce a specific risk factor for asthma exacerbation, through increased healthcare or education.

### *Access to Healthcare*

Healthcare is a key factor in establishing severity of childhood asthma. Therefore, it is not surprising that many studies have examined whether increased availability to treatment reduces disease inequalities between advantaged and disadvantaged populations.

Several studies examine the possibility that the institution of universal healthcare in the United States would eliminate impoverished asthma prevalence and severity. The previously mentioned study of children in Sheffield, England determined that degree of deprivation impact both disease prevalence and severity. Progressively increasing levels of deprivation are associated with progressively increasing disease prevalence and with increasing amount of symptom expression despite universal access to healthcare through England's National Health Service (Ng Man Kwong et al, 2002). A similar study examined health status of children in Canada, in which the government provides all citizens with nearly identical access to healthcare through a government-funded single-payer system with very little permitted cost-sharing. In addition, poor and very poor

Canadians, as measured by total income, receive governmental assistance for pharmaceuticals, suggesting little difference in healthcare access among citizens. Investigators measuring asthma severity found that while there was little difference in emergency department access between nonpoor and poor children, the very poor were significantly more likely than the other groups to seek emergency treatment for asthma. Controlling for other risk factors such as birth weight and family status still revealed an increased risk for emergency treatment among the very poor (Sin et al, 2003). This reduction in health inequity between income groups compared with American studies suggests that access to medical care may play a role in childhood asthma severity; however, the remaining disparity between advantaged and disadvantaged children in universal healthcare systems indicates that the inequalities do not simply stem solely from unequal access to physicians and pharmaceuticals. Implementation of universal healthcare in the United States would likely reduce asthma severity in more disadvantaged populations partially, but not fully. Increasing access to healthcare is a component of improving asthma outcomes, but not the entire solution.

### *Healthcare Quality*

Access to healthcare alone does not ensure thorough asthma treatment and subsequent reduction in likelihood of increased severity. Quality of healthcare, or lack thereof, also has a powerful effect on disease outcome. Within the clinical setting, providers must accurately diagnose patients, then educate families of asthma danger and management. Pediatricians who also look beyond the doctor's office can be significantly more effective at treating any childhood diseases, including asthma.

Obtaining an individual and family history of disease contributes to accurate, effective diagnoses and ultimately treatments. Educating families about reducing asthma

is also an important component of adequate healthcare. Then there are physicians that not only look beyond the office, but act there as well. Dr. Barry Zuckerman and his team of lawyers have had a significant impact on reducing environmental risk factors in homes. Dr. Zuckerman saw countless asthmatic children who received the education and medication they needed, but whose symptoms were not alleviated because of substandard housing conditions. Frustrated, he began hiring lawyers to call landlords, demanding they eliminate destructive allergens from their properties. Most, if not all, landlords eventually complied and children's conditions dramatically improved. Today, the pediatrics department of the Boston Medical Center employs five full-time lawyers specifically for this purpose (Shipler, 2004).

Another pediatrician, Dr. Joshua Sharfstein, has also taken important, unconventional strides to improve patient health. He realized that the reason many children miss important follow up visits is not because of parental irresponsibility, but rather because many families lack flexibility. Often, impoverished single mothers work restrictive jobs that prevent their ability to meet daytime appointments. Recognizing this, Dr. Sharfstein now personally calls employers to persuade them to permit maternal absences, an act that has led to improved health for many asthmatic children (Shipler, 2004). For these physicians, adequate healthcare involves providing the patient with medical treatment, education, and a more powerful voice.

### *Education*

Recognizing the multi-dimensional aspect of adequate healthcare, a number of studies examine the possibility of using specialized programs to provide the beneficial educational aspect of healthcare separate from the medicinal.

It may be possible to utilize community schools to educate children and their parents about asthma and its management, with the hope that such intervention will enhance outcome, reducing prevalence and severity disparities. One study examined the use of schools to enable parents to diagnose asthma. Investigators distributed questionnaires assessing presence of children's asthmatic symptoms to parents through predominantly low-income, minority schools. Subsequent physician examination revealed that a large majority (94%) of children with parent-identified asthma were in fact asthmatic (Brito et al, 2000). These findings indicate that properly managed parental assessments of childhood asthma could help reduce diagnostic inequalities and associated outcomes of the impoverished.

Other school-based programs may directly improve health outcomes of African American inner-city asthmatic children. Investigators instituted the Open Airway Educational Program in eight inner-city public elementary schools to educate asthmatic children in techniques of disease management, including recognition of symptoms, proper use of medication and healthcare, safe physical activity, control of symptom triggers, and minimization of disease impact on academic and social functioning. Asthmatic symptom expression was significantly reduced for children who went through the Open Airways program compared with their uneducated peers. In addition, educated children were more likely than uneducated ones to seek emergency treatment; however, medication use and psychosocial outcome did not differ between the two groups (Velsor-Friedrich et al, 2004). These results suggest that greater asthma education may have an impact on severity, but it does not eradicate all its components.

Other methods of community outreach that educate low-income minority populations in methods of optimal asthma management may also have an impact. One study that examined the use of training programs in well-established community centers

that involve promotional campaigns, management education, and improvement of overall neighborhood asthma awareness found that the numbers of acute care visits in highly-involved children are reduced. Uninvolved asthmatic children living in neighborhoods with these programs used acute care at similar rates to children in uneducated, control communities (Fisher et al, 2004). The degree of participation affects program efficacy, raising the question of how to reach out to those that are less involved in community organizations. One study examined the use of more invasive means of monitoring and education to maximize adherence to asthma management plans. A nurse held four weekly at-home meetings with inner-city African American children and their families, instructing them of basic asthma and management information. Children were also fitted with electronic monitors that measured adherence to medicinal management plans. The number of children with ideal medicinal use increased over the four-week duration of the study, indicating that such intensive interventions have some impact on management behaviors (Bartlett et al, 2002). Investigators failed to examine symptom expression throughout the duration of the study; therefore, few conclusions can be drawn between resultant management and effect on asthma severity. A large proportion of children receiving this instruction continued to improperly treat the disease. In addition, the study failed to examine behaviors following cessation of instruction and monitoring, when management would likely deteriorate. This suggests that even intensive educational programs do not completely eliminate impoverished asthma incidence and additional institutions may be necessary.

### *Cost-Effectiveness*

Critics of intensive asthma intervention cite excessive program costs. One study sought to eliminate these concerns and increase public funding to such programs by

comparing costs and health effects of program-educated impoverished children to Medicaid costs and health effects in ones receiving traditional care. Results showed that over a two-year period, children in the intervention group, with involvement of specially-trained asthma counselors, had an average of above 26 more symptom-free days than those of the control group, resulting in significantly reduced average medical costs. After accounting for differences in Medicaid costs caused by decreased emergency care, costs for treatment for children in the intervention group cost a total of \$337 more than that of the traditional treatment group (Sullivan et al, 2002). The substantial increase in health outcome for this group, and its subsequent implicit psychosocial improvements, is significant enough to justify this small increase in public cost.

### Conclusions

Childhood asthma among the impoverished is a complicated problem influenced by multiple factors. Consequently, a solution to reduce disparities between advantaged and disadvantaged populations should be multifaceted, addressing as many of these risk factors as possible. An ideal solution to ending disparities is a comprehensive combination of healthcare and educational advancements. First, impoverished populations should have access to sufficient healthcare, a lack of which is a primary contributing factor to asthma severity. This is also a multidimensional component. Most importantly, healthcare must be reliable and consistent. An accurate diagnosis of condition and severity can only be made through repeated visits to the same clinician. Frequent follow-ups allow for monitoring of asthma development, permitting treatment modification. It also provides an opportunity for patient and family education about the disease and its management, including emphasis on the gravity of the disease and on lifestyle changes that could reduce its exacerbation. Similarly, the most beneficial

medications should be available to all patients, regardless of income. In addition, physicians should be informed of proper methods of patient treatment and education, eliminating differences in diagnosis and treatment strategies for children of different races and incomes.

Exposure to environmental factors, such as tobacco smoke, pollution, and pest allergens, contributes to both the development and exacerbation of childhood asthma. Elimination of these known risk factors would reduce prevalence and severity of asthma in impoverished communities. This could be accomplished through stricter government legislation and enforcement. It could also be done through less formal means, such as through the clinical environment. As Dr. Zuckerman and the Boston Medical Center showed, hiring lawyers on behalf of the patient can be instrumental in improving housing conditions for the impoverished. The best way to diminish environmental disparities between the rich and the poor may be to provide the impoverished with a more powerful political voice.

Finally, a comprehensive solution for the eradication of asthma inequalities should work to adequately educate the public about asthma's effects and its treatment. If patients are made more aware of the grave, yet treatable nature of the disease, they may be more likely to seek care and follow management plans. In addition, greater public knowledge of the disease would pressure physicians to provide impoverished patients with more thorough diagnoses and treatments. Community-wide knowledge would provide a support system capable of encouraging individuals to seek quality care.

Little attention is currently being paid to the problems of childhood asthma in impoverished communities. Few governmental programs are in place to address the multiple components contributing to childhood asthma. There are few governmental programs or agencies directly addressing asthma education and treatment and only ten



states have programs designed to improve indoor air quality. There is insufficient knowledge in impoverished communities of asthma's considerable negative consequences. In addition, many physicians are unaware of disparities in disease severity and prevalence and the best manner in which to remedy them (LeNoir, 1999). Steps must be taken to improve awareness of a prominent problem.

Childhood asthma is a complicated disease caused by numerous, interrelated factors. It disproportionately affects minority and impoverished communities in a multi-dimensional manner, through variances in healthcare, education, and environment, further disadvantaging an already disadvantaged population. Consequently, an effective approach to eradicating disparities and ultimately improving impoverished conditions must be multi-faceted, addressing as many components of the disease as possible.

Every day, Isaiah struggles to overcome the many stresses of life in his impoverished, inner-city community. Reduction of any of these could significantly improve his chances of surmounting his difficulties. Improved treatment could help reduce Isaiah's asthma symptoms and severity, ultimately preventing the disease from becoming another obstacle to his achievement of a successful adulthood.

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