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# Social Determinants: Taking the Social Context of Asthma Seriously

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## ABSTRACT

Although asthma has emerged as a major contributor to disease and disability among US children, the burden of this disease is unevenly distributed within the population. This article provides a brief overview of social-status variables that predict variations in asthma risks and social exposures, such as stress and violence, that are emerging as important risk factors. The central focus of the article is on the distal social variables that have given rise to unhealthy residential environments in which the risk factors for asthma and other diseases are clustered. Effective initiatives for the prevention and treatment of childhood asthma need to address these nonmedical determinants of the prevalence of asthma. *Pediatrics* 2009;123:S174–S184

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### Key Words

childhood asthma prevalence, low-income population, poverty, race, risk factors

### Abbreviations

ICS—inhaled corticosteroid

SES—socioeconomic status

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THE REVIEW BY Gold and Wright<sup>1</sup> demonstrated a pattern of childhood asthma risk in the US population on the basis of race/ethnicity and socioeconomic status (SES). Nonwhite children residing in urban areas and children living in poverty have a significantly higher risk of asthma and higher disease morbidity than do white children; for example, asthma prevalence, hospitalization, and mortality rates are higher for black children than for white children. Puerto Rican individuals have an elevated risk of asthma, compared with other Hispanic populations. Indicators of area deprivation also are positively related to childhood asthma prevalence and hospitalization rates, which suggests that SES characteristics at the individual, household, and community level affect a child's risk of asthma.<sup>2</sup>

Race/ethnicity and SES are related but not interchangeable systems of social ordering that affect health risks. Considering how these systems simultaneously affect the distribution of disease can be informative. In the United States, for example, the risk of infant death varies according to the mother's education and race; for women in all racial/ethnic categories, the risk of infant death decreases as the mother's education increases. However, the persistence of a racial disadvantage at every level of education is so marked that black women who have graduated from college have higher infant mortality rates than do white, Asian, or Hispanic women who are high school dropouts.<sup>3</sup> The joint effects of race/ethnicity and SES are not typically considered in the study of childhood asthma; however, an examination of asthma prevalence for children <18 years of age by using National Health Interview Survey data revealed that the risk is particularly high among children with disadvantages in both racial status and SES.<sup>4</sup> The study found that, whereas black children had a higher prevalence of asthma than did white children, the prevalence rates among Hispanic children and white children were similar. Although there were no racial differences in asthma rates at moderate and high income levels, black children had twice the risk of asthma, compared with white children, among families with incomes less than one half of the federal poverty level.

## CONCENTRATION OF ILLNESS AND SOCIAL ADVERSITY

The social patterning of disease is not limited to childhood asthma. Disadvantaged social status predicts higher morbidity and mortality rates for a broad range of conditions in both children and adults.<sup>5,6</sup> Moreover, illness and social adversity tend to cluster in the same people and places, so that individuals and areas that are at risk for 1 adverse condition tend to be at risk for multiple social ills. The social distribution of childhood asthma must be understood and addressed in the context of concurrent, multiple, adverse living conditions. It is worth noting that consensus statements by both the Institute of Medicine of the National Academies<sup>7</sup> and the National Institute of Environmental Health Sciences<sup>8</sup> support the position that examining disparities in environmental health requires attention to both environmental hazards and social conditions.<sup>9</sup>

Research reveals an association between growing up in conditions of childhood poverty and elevated exposure to a broad range of health-damaging conditions.<sup>10</sup> Compared with high-SES children, poor children are exposed to higher levels of family turmoil, violence, separation, instability, and chaotic household conditions; experience less support; and have parents who are less responsive and more authoritarian. Poor children also are read to less

frequently, watch more television, have less access to books and computers, and are less likely to have parents involved in their school activities. The comprehensive review by Evans<sup>10</sup> of the negative correlations of childhood poverty also indicates that, compared with high-SES children, poor children are more likely to consume polluted air and water; to reside in noisier, lower-quality, and more-crowded homes; to live in more-dangerous neighborhoods, with greater physical deterioration and poorer city services; and to attend inferior schools and day care centers. Members of ethnic minorities and individuals in lower socioeconomic positions also may experience greater psychological stress, which may be compounded by the presence of overburdened or absent social supports, psychological morbidity (eg, anxiety or depression), and lack of control over their lives and environments.<sup>11</sup>

The problems linked to poverty cut across racial lines. Although the rate of poverty in the United States is higher for members of racial and ethnic minorities than it is for white individuals, the majority of poor persons in the United States are white.<sup>12</sup> Some research indicates that a larger proportion of minority poor individuals experience severe poverty (50% of the poverty threshold), compared with white poor individuals.<sup>13</sup> In 2005, black individuals earned 61 cents and Hispanic individuals earned 71 cents for every 1 dollar earned by white individuals.<sup>12</sup> Furthermore, racial/ethnic differences in wealth persist at every level of income; for every 1 dollar that white individuals have, black individuals have 9 cents and Hispanic individuals have 12 cents.<sup>14</sup> Among persons whose income falls in the bottom 20% of all US households, black individuals have 1 cent and Hispanic individuals have 2 cents for every 1 dollar of wealth that white individuals have. Additional evidence that black poor individuals are poorer than white poor individuals came from a large federal survey that documented that, even after adjustment for a broad range of socioeconomic, demographic, and household characteristics, black individuals were more likely than white individuals to have experienced 6 economic hardships during the previous year.<sup>15</sup> For example, black individuals were more likely than white individuals to have been unable to pay their rent, mortgage, or utility bill; to have had their utilities or telephone service shut off; and to have been evicted from their apartment. The greater economic deprivation of black individuals is also evident at the neighborhood and community levels. Research reveals that black individuals and Puerto Rican individuals live in worse neighborhoods than do white individuals with comparable incomes.<sup>12</sup> In fact, in none of the 171 largest cities in the United States did black individuals and white individuals live in comparable neighborhood conditions, in terms of poverty rates and proportions of single-parent households.<sup>16</sup>

Social adversities that affect health risks also accumulate over the life course. Exposure to poor socioeconomic conditions during childhood has been shown to have long-term negative effects on adult health and functioning. For example, for both black and white individuals and both men and women in the Coronary Artery Risk

Development in Young Adults study, low childhood SES, measured as parental education level, was associated with poorer baseline pulmonary function among adults and greater decreases in pulmonary function, as assessed on 3 occasions during a 5-year period.<sup>17</sup> This graded association remained significant even after adjustment for current SES, asthma history, smoking history, and other risk factors. Evolving research, summarized below, suggests that different exposures to stressors and adverse residential conditions over the life course, both independently and cumulatively, may have implications for asthma.

## STRESS AND ASTHMA

Although physical characteristics of neighborhood and housing environments, such as air pollution, dampness, dust, and the presence of pests, contribute to variations in the risk of asthma within populations, these factors alone do not fully account for the social distribution of childhood asthma.<sup>2,18</sup> Evidence suggests that the social patterning of asthma reflects different exposures to pathogenic factors in both the physical and social environments. The social environment may contribute to asthma risk through upstream social factors that determine different exposures to relevant asthma pathogens<sup>11,19,20</sup> and through the experience of psychological stress, which is being linked increasingly to asthma expression.<sup>21,22</sup> The National Cooperative Inner-City Asthma Study examined psychosocial factors and asthma morbidity for 1528 urban children (4–9 years of age) and found that 50% of caretakers reported clinically significant levels of psychological distress symptoms on the Brief Symptom Inventory.<sup>23</sup> Moreover, the caretaker's mental health (but not the child's) was the strongest predictor of asthma hospitalizations among these children.

Much of the association between SES and health disparities may be determined through increased exposure to acute and chronic stress, compounded by the presence of overburdened or absent social supports, psychological morbidity (eg, anxiety or depression), and lack of control over one's life.<sup>11</sup> Ecological views on health recognize that individual-level health risks and behaviors have multilevel determinants, in part influenced by the social context within which the individual lives; that is, the degree of chronic stress is significantly influenced by the characteristics of the communities in which we live.<sup>24</sup> One type of chronic stress that has been investigated in relation to urban children's development is neighborhood disadvantage, which is characterized by the presence of a number of community-level stressors, including poverty, unemployment/underemployment, limited social capital or social cohesion, substandard housing, and high crime/violence exposure rates. In the United States, many urban communities are characterized by a high neighborhood disadvantage level.<sup>25</sup>

The evidence on the determinants of health disparities among racial and ethnic minorities and low-SES populations points to the powerful influence of community characteristics in promoting health and well-being. One potential mediating feature of community life that

has generated considerable attention is the concept of “social capital.” Social capital and related constructs have been linked to a community’s economic development, investment in public goods such as education, and crime/violence rates.<sup>26</sup> Ongoing work by Wright et al<sup>27</sup> has identified violence exposure as a prevalent factor that influences asthma morbidity in US urban communities. Social capital is strongly correlated with violent crime rates, which affect community resilience by undermining social cohesion.<sup>28,29</sup> Therefore, high rates of violence and crime within a community and society not only are chronic psychosocial stressors but also are indicators of compromised collective well-being and nonoptimal social relationships, or social cohesion.<sup>30</sup>

### **EMPIRICAL EVIDENCE LINKING VIOLENCE TO ASTHMA MORBIDITY**

The Moving to Opportunity study sponsored by the Department of Housing and Urban Development suggests that there may be an important link between asthma and violence. The Moving to Opportunity study used a randomized lottery that allowed families from high poverty areas (ie, census tracts with >40% of the population at or below the poverty level) and public housing to receive vouchers to pay for rental housing from private landlords in census tracts with <10% poverty.<sup>31</sup> The study found that families with children with asthma who moved to apartments in better neighborhoods rated their children’s asthma as less severe after the move, independent of other risk factors. In the initial phases of the Moving to Opportunity study, in-depth interviews with community residents from the cohort in Boston, Massachusetts, indicated that stress regarding community violence and worry about safety were important to their health and their greatest motivations for wanting to move.<sup>32</sup> Although the initial hypothesis regarding the benefits of moving participants from high-poverty to low-poverty neighborhoods centered on quality housing and reduced exposure to indoor allergens, qualitative data collection redirected the focus of the quantitative survey to include the domains of violence, crime, safety, and health.

In a study of 851 children (5–12 years of age) and their caretakers enrolled in the Inner-City Asthma Study, Wright et al<sup>27</sup> demonstrated an association between higher levels of community violence and increased caretaker-reported asthma symptoms. The caretakers reported on community violence prevalence, other negative life events, perceived stress, unwanted thoughts and memories (rumination), caretaker behaviors (eg, keeping children indoors, smoking, and medication adherence), and sociodemographic factors (eg, income, employment, race/ethnicity, and housing quality). Increased frequency of exposure to violence in the communities predicted a greater number of asthma symptom days among the children, even after controlling for socioeconomic factors and housing dilapidation. Caretakers who reported high-level violence in these analyses also were more likely to ruminate. Ongoing rumination may affect problem-solving skills, erode perceived control, and decrease motivation to manage on-

going challenges, including management of a chronic illness such as asthma. Caregivers who use ruminative coping strategies may experience greater stress and psychological comorbidity, especially depression, which, as noted previously, may directly influence the child. A caretaker’s psychological adjustment may affect the child’s asthma morbidity by contributing to a less-effective parenting style, inappropriate utilization of health care services, and poor medication adherence.

In a cohort study in Boston, Massachusetts, Wright and colleagues<sup>33</sup> retrospectively ascertained lifetime exposure to violence through an interview questionnaire administered to caregivers and their children, who were monitored longitudinally for respiratory health outcomes, including asthma. Analyses suggested a link between greater lifetime exposure to community violence and increased risks of asthma and wheeze syndromes and prescription bronchodilator use.<sup>33</sup> In additional analyses, the same research group examined the potential for exposure to community violence to interact with exposure to air pollution.<sup>34</sup> Geographic information system-based models were developed to retrospectively estimate residential exposures to traffic-related air pollution for 413 children in an urban, community-based, pregnancy cohort recruited between 1987 and 1993 in Massachusetts, by using monthly nitrogen dioxide measurements collected at 13 sites over 18 years. By merging pollution estimates with questionnaire data on lifetime exposure to violence (considered as a chronic stressor) and prospectively collected, repeated-measures data on asthma onset in these urban children, the investigators explored the hypothesis that stress enhances the susceptibility to air pollution in childhood asthma pathogenesis. This approach could be justified, given the potential spatial covariance across exposures and the potential influence of stress and pollution on common physiological pathways (ie, oxidative stress) and health outcomes (ie, respiratory disease).<sup>21</sup> With corrections for potential confounders, including gender, SES, race/ethnicity, tobacco smoke exposure, and lower respiratory tract illnesses, the investigators found an elevated risk of asthma with a 1-SD (4.3-ppb) increase in nitrogen dioxide exposure specifically among children with above-median violence exposures. Among children who had spent their entire lives in the same community, this association was even stronger.

Similar hypotheses could be explored in relation to the psychological impact of other environmental conditions that are distributed differently according to SES. For example, housing conditions may result in different exposures to important physical environmental risk factors (eg, allergens)<sup>20</sup> and increased psychological stress.<sup>18</sup>

### **RACIAL RESIDENTIAL SEGREGATION**

#### **History and Current Status of Segregation**

Asthma is a disease of multifactorial causation, and there seems to be a complex web of factors linking specific household and residential conditions to the risk of asthma. Effective long-term interventions for reducing asthma risk will require identification and elimination of

the factors in this complex web of causation.<sup>35</sup> As discussed below, evidence suggests that residential segregation is a central determinant of black/white disparities in SES at the individual, household, and neighborhood levels and, thus, is a fundamental cause of racial disparities in health in the United States.<sup>5</sup>

Segregation refers to the physical separation of the races through enforced residence in restricted areas. It developed in the late 19th and early 20th centuries in the United States, to protect white individuals from residential proximity to black individuals. One of the most striking features of segregation is its persistence over time, despite dramatic societal changes with regard to race. In the 2000 US Census, the dissimilarity index (a widely used measure of segregation) was 66, meaning that two thirds of black individuals would need to move to ensure an even distribution within the population.<sup>36</sup> Although there has been a modest decrease in segregation in recent decades, most of it has been attributable to a few black individuals moving into formerly all-white residential areas; this decrease in segregation has not reduced the number of very high-proportion black census tracts, the residential isolation of most black individuals, and the concentration of urban poverty.<sup>36</sup> Table 1 highlights some of the challenges that segregation poses for children. Table 1 presents sociodemographic information for the 10 most-segregated and the 10 least-segregated metropolitan areas with the largest populations in the United States. Table 1 shows the segregation scores (dissimilarity index values) for many of the largest US cities, including Detroit, Michigan, Milwaukee, Wisconsin, New York, New York, Chicago, Illinois, and Cleveland, Ohio; for comparison, the scores for these cities are only slightly lower than the score of 90 for South African cities in 1991, during apartheid.<sup>37</sup>

The level of residential segregation for black individuals is distinctive; historically and currently, black individuals are more segregated than any other racial/ethnic group in the United States.<sup>38</sup> Moreover, although segregation is inversely related to income for Hispanic individuals and Asian individuals, segregation is high at all levels of income for black individuals. The most affluent black individuals (those with household incomes of >\$50 000) are more segregated than the poorest Hispanic individuals and Asian individuals (those with household incomes of <\$15 000).<sup>37</sup> Importantly, the residential segregation of black individuals does not simply reflect their preferences for residence in segregated areas; both national and regional studies have found that black individuals manifest a greater preference for residing in integrated areas than any other racial groups.<sup>39</sup>

Observers of US society have long noted that segregation plays a key role in shaping socioeconomic opportunities for black individuals. In his seminal 1944 treatise on race in the United States, Myrdal<sup>40</sup> argued that, although its influence was indirect and impersonal, residential segregation was nonetheless fundamental to understanding racial inequality in the United States. After the urban riots of the 1960s, the Kerner Commission noted that residential segregation was the “linchpin” of US race relations and the source of the large and growing

racial inequality in SES.<sup>41</sup> Historian John Cell<sup>42</sup> argued that residential segregation was one of the most-successful US domestic policies of the 20th century, and sociologists Massey and Denton<sup>38</sup> amassed evidence indicating that residential segregation is “the key structural factor responsible for the perpetuation of black poverty in the United States” and “the missing link” in efforts to understand urban poverty.

Research reveals that segregation may affect health in general, and asthma in particular, in multiple ways. As a key determinant of racial differences in SES, segregation produces concentrations of poverty and social isolation and creates pathogenic conditions in social and residential environments.

### Segregation, Discrimination, and SES

Audit studies in which trained black and white job applicants with identical resumes applied for employment found that, rather than being equally likely to get the job, white applicants were 20% more likely to be chosen than were black applicants.<sup>43</sup> In addition to this employment discrimination at the individual level, institutional discrimination based on residential segregation restricts access to jobs. In the past several decades, low-skilled, high-paying jobs have migrated from the urban segregated areas where black individuals are concentrated to suburban areas.<sup>44</sup> Negative racial stereotypes of black individuals and the areas where they are concentrated have been shown to play a role in this migration. An analysis of >35 000 US companies found that, during routine corporate restructuring, relocation, and downsizing during the economic downturn of 1990–1991, jobs were moved systematically from urban areas with high concentrations of black individuals to suburban and rural areas, where the proportions of black individuals in the labor force were small.<sup>45</sup> For example, because Sears relocated inner-city distribution centers to suburban communities, black individuals accounted for 54% of the job losses at that company, although they were only 16% of the workforce. As a consequence of similar actions among US corporations, black individuals represented the only racial group that experienced a net loss of jobs in 1990–1991. Other research revealed that corporations explicitly use the racial composition of areas in their decision-making processes regarding the locations of new plants and the relocation of existing plants.<sup>46</sup> A study of the effects of segregation on young black adults found that the elimination of segregation would completely erase black/white differences in income, education, and unemployment and would reduce racial differences in single motherhood by two thirds.<sup>47</sup>

The legacy of segregation is strikingly evident in Table 1. Although the average poverty rate for white children is relatively constant at ~7% in both high- and low-segregation areas, the black child poverty rate is greater in high-segregation areas (mean: 36%) than in low-segregation areas (mean: 28%). More importantly, the poverty rate for black individuals even in relatively low-segregation areas is 4 times higher than the poverty rate for white individuals in those areas. The overrepresentation of black children in areas of concentrated poverty also is alarmingly high. With

**TABLE 1 Characteristics of Metropolitan Areas According to Race and Levels of Segregation**

Metropolitan Area	Dissimilarity Index <sup>a</sup>	Population, × 1000	Black, %	Poverty Rate, %						Area Homeownership Rate, % <sup>d</sup>				Prenatal Care, %				Pregnant Smoker, %				Crime, Cases per 100 000 <sup>e</sup>							
				Overall		In High-Poverty Areas <sup>b</sup>		In Low-Income Areas <sup>c</sup>		Black Children		White Children		Black Children		White Children		Black		White		Black		White		Murder		Robbery	
				Black Children	White Children	Black Children	White Children	Black Children	White Children	Black Children	White Children	Black Children	White Children	Black Children	White Children	Black Children	White Children	Black	White	Black	White	Black	White	Black	White	Murder	Robbery		
<b>High segregation</b>																													
Detroit, MI	85	4442	23.4	32.5	7.2	61.3	4.8	79.7	13.5	57.9	81.1	64.9	88.5	13.4	14.8	10	177.6												
Gary, IN	84	631	19.8	36.2	7.1	64.9	3	76.9	9.2	54	78.3	63.2	81.8	12.2	19.7	13.1	141												
Milwaukee, WI	82	1501	16	42.9	4.3	67	3.3	88.1	8.6	42	71.9	59.6	89.4	17.3	11.9	6.2	190.5												
New York, NY	82	9314	23.8	32.3	13.3	65.3	20.7	60.2	16.1	27.5	52.7	54.3	73.4	4.3	2.7	6.4	273.4												
Newark, NJ	80	2033	22.5	25.2	3.9	40.9	1.5	77.9	9.2	36.7	77.7	44.7	82.2	11.4	7.6	8	218.1												
Chicago, IL	80	8273	19	33.2	3.9	52.5	1.4	72.8	6.8	48.8	79.2	64.4	86.2	12.1	7.8	14.3	491.3												
Cleveland, OH	77	2251	18.9	37.2	7.8	59.3	6.2	73.2	12.4	50	77.3	69.5	86.3	12.6	15.9	4.6	189.5												
Buffalo, NY	77	1170	12	44.3	9.2	85.8	9	87.7	13.8	44.6	73.5	46.5	77.2	19.6	17.9	5.6	166.4												
Cincinnati, OH	74	1646	13.4	37.5	8	49	3	65.5	19.5	42.6	74.8	70.1	89.9	13.3	19	5.5	189.9												
St Louis, MO	73	2604	18.7	37.0	6.5	51.9	2.9	75.4	12.9	57.5	78.4	67.6	90.2	12.1	15.7	7.6	168.6												
Average score	79	3387	18.8	35.8	7.1	59.8	5.6	75.7	12.2	46.2	74.5	60.5	84.5	12.8	13.3	8.1	220.6												
<b>Low segregation</b>																													
Jacksonville, FL	54	1100	21.9	29.1	8.4	34.5	2.6	50.8	14.8	61.1	73.3	72.5	88.0	4.7	15.6	9.5	202.9												
Charlotte, NC	54	1499	20.7	24.0	6.3	26.3	1.6	50.4	13.8	56.6	76.5	71.3	86.7	9.7	14.8	6.1	233.0												
Oklahoma City, OK	53	1083	11.2	39.4	11.4	50.7	13.4	59.6	21.2	55.9	71.2	65.9	79.2	15.6	19.7	4.8	127.4												
Wilmington, DE	53	586	18.2	22.5	5.1	22.1	2.1	50.4	11.3	59.3	77.1	79.2	90.7	12.8	15.1	4.1	183.1												
Columbia, SC	51	537	32.3	26.5	6.6	30.2	3.8	50.2	15.4	62.0	78.3	66.6	82.4	6.7	13.7	8.6	188.6												
Vallejo, CA	51	519	12.5	19.3	7.7	4.8	1.4	35.2	17.0	62.7	67.3	64.8	77.3			5.5	133.9												
Norfolk, VA	46	1570	31.5	28.8	6.4	32.6	3.6	51.5	14.8	53.1	70.8	72.7	88.7	4.6	9.1	6.8	164.5												
Raleigh, NC	45	1188	23.0	23.3	4.6	22.3	2.4	50.2	13.5	58.6	74.4	69.3	89.4	9.6	7.8	6.1	151.1												
Charleston, SC	44	549	31.1	31.0	9.2	28.4	5.3	46.3	12.9	63.0	71.4	73.0	88.9	5.7	13.7	4.3	163.8												
Greenville, SC	44	962	17.7	36.0	7.1	35.7	5.2	46.8	12.8	62.3	76.8	63.1	79.7	9.8	17.2	6.8	111.0												
Average score	50	959	22.0	28.0	7.3	28.8	4.1	49.1	14.8	59.5	73.7	69.8	85.1	8.8	14.1	6.3	165.9												

Data were obtained from the US Census Bureau Current Population Survey, 2000, the National Center for Health Statistics, 2001–2002, and the Federal Bureau of Investigation Uniform Crime Reporting Program, 2004, through the Diversity Data Web Resource (<http://diversitydata.sph.harvard.edu>).

<sup>a</sup> The dissimilarity index indicates the evenness with which black individuals are located within a metropolitan area, with respect to white individuals.

<sup>b</sup> High-poverty areas are neighborhoods in which 40% of residents are at or below the poverty level.

<sup>c</sup> Low-income areas are neighborhoods in which the median family income for the Census tract is <80% of the median family income of the metropolitan area as a whole.

<sup>d</sup> Home-ownership rates in the average neighborhood in which each racial group lives.

the definition of high-poverty areas as neighborhoods where  $\geq 40\%$  of the residents live in poverty, Table 1 shows that a staggering 60% of black children in highly segregated metropolitan areas live in high-poverty areas, compared with 5.6% of white children. In low-segregation metropolitan areas, the proportion of black children in high-poverty neighborhoods is 29%, whereas the rate for white children is 4.1%.

### Segregation and Neighborhood Quality

Residential segregation has led to unequal access to a broad range of services provided by municipal authorities. Segregated residential areas typically are characterized by a disinvestment of economic resources in those neighborhoods, which tends to predict poor quality of life in multiple dimensions. Because residents of these areas tend to be less active politically and have little economic clout, elected officials are less likely to encounter vigorous opposition when services are reduced in these areas. One study of the 171 largest metropolitan areas in the United States concluded that the worst urban context in which white individuals reside is better than the average context of black communities.<sup>16</sup> These distinctive ecological environments can affect asthma adversely in multiple dimensions. For example, segregation may lead to poor residential conditions, such as crowding, which may predispose residents to viral illnesses,<sup>48</sup> and deteriorating housing stock, which may increase exposure to indoor allergens.<sup>20</sup>

Segregation also is associated with elevated exposure to physical and chemical risks, as well as to social disorder.<sup>1,49</sup> Research reveals that segregated, inner-city areas have higher rates of air pollution, such as ozone and ambient particulate matter, which can exacerbate asthma symptoms.<sup>50,51</sup> A longitudinal study of school-aged children with asthma in Detroit, one of the nation's most segregated cities, found that, where levels of air pollution were above the National Ambient Air Quality Standards, lung function was affected adversely.<sup>52</sup> Residence in highly segregated areas also is associated with increased personal and property crime rates. As shown in Table 1, the average murder and robbery rates in high-segregation metropolitan areas were  $\sim 24\%$  higher than those in low-segregation areas. The risks of exposure to stress, violence, financial strain, family separation, chronic illness, death, and family turmoil are higher among poor persons in segregated areas and, as noted earlier, there is a link between violence exposure and asthma, as well as a link between stress exposure and asthma.

Research reveals that the conditions in segregated areas can affect the practice of healthy behaviors.<sup>53</sup> Poor health behaviors can increase both asthma morbidity and susceptibility.<sup>54,55</sup> Segregated areas are less likely to have recreational facilities such as playgrounds and swimming pools. They are more likely to have retail outlets for tobacco, alcohol, and fast foods and to be the targets of marketing campaigns for these substances. Table 1 shows that black women in highly segregated areas are more likely to smoke while pregnant. A study of multiple communities found that wealthy neighbor-

hoods had 3 times as many grocery stores as low-income neighborhoods, and white neighborhoods had 4 times as many food stores as black ones.<sup>56</sup> Black neighborhoods also had fewer grocery stores within a 5-minute travel distance.<sup>57</sup> A Detroit study found that, among the most-impovertised neighborhoods, majority-black neighborhoods were an average of 1.1 miles farther from the nearest supermarkets than were white neighborhoods.<sup>58</sup>

Other research reveals that the food available in grocery stores tends to be of lesser quality in poor segregated areas. A report by the US Select Committee on Hunger concluded that grocery stores located in inner-city neighborhoods offer a poorer selection and less fresh food.<sup>59</sup> The scarcity of high-quality food sources serves as a significant barrier to healthy eating. For example, a study of grocery stores in 12 communities found a significant relationship between the availability of healthful grocery products and a healthy individual diet.<sup>60</sup> A major study of 10 000 adults in North Carolina, Mississippi, Minnesota, and Maryland concluded that black individuals living in a census tract with  $\geq 1$  supermarket were more likely to meet national dietary health guidelines for fruit and vegetable consumptions and fat intake than were black individuals living in neighborhoods with no supermarkets. Moreover, for every additional supermarket, produce consumption increased by 32%.<sup>56</sup> The lack of local supermarkets may significantly hinder inner-city residents in obtaining nutritious food.

Substantial evidence indicates that purchasing power is less in segregated areas because the costs of a broad range of goods and services, including food, are higher in those areas. Chung and Myers<sup>61</sup> conducted a study of grocery store access and prices in the Minneapolis and St Paul, Minnesota, metropolitan area by examining 50 items in 526 stores in inner-city and suburban neighborhoods. They found that, although chain grocery stores charged similar prices in poor and nonpoor neighborhoods, such stores were significantly less likely to be located in poor neighborhoods. Only 22% of the chain grocery stores were located in inner-city areas, whereas nearly one half of the convenience stores and small grocery stores (in which prices were higher than those in convenience stores) were located in inner-city areas. Because residents in low-income areas have less access to healthy foods such as fruits and vegetables, they often select the least-expensive and most-filling foods, often at a cost to their health.<sup>60</sup>

The lack of accessible healthy food may influence asthma through an increased risk of obesity. Studies indicated that low-SES neighborhoods and areas lacking healthy food sources exhibit higher rates of obesity,<sup>62</sup> whereas areas with supermarkets have lower rates.<sup>63</sup> Obesity is a documented risk factor for asthma pathogenesis and morbidity for both children and adults.<sup>64-67</sup> In addition, there is some evidence that inadequate dietary antioxidant intake may increase the risk of asthma and/or decrease children's pulmonary function.<sup>68-71</sup>

### Segregation and Medical Care

Segregation can adversely affect access to medical care and to high-quality care. Pharmacies in segregated

neighborhoods tend to have inadequate medication supplies,<sup>72</sup> and hospitals in these areas are often characterized by limited resources, overcrowding, staff shortages, and outdated equipment and are more likely to close.<sup>73</sup> Greene et al<sup>74</sup> determined that, in areas where the poor are nonwhite and in racially segregated areas, physicians are significantly less likely to participate in Medicaid. Other research indicated that the overall quality of care is lower in residentially segregated areas,<sup>75</sup> with black individuals receiving most of their care from a small group of physicians who are less likely than other doctors to be board-certified and are less able to provide high-quality care and referral to specialty care.<sup>76</sup> Table 1 shows that, although rates of receipt of prenatal care are similar for white women in high- and low-segregation areas, black women in high-segregation areas are significantly less likely to receive prenatal care than are their counterparts in low-segregation areas.

The challenges of access to care linked to segregation are intensified by racial disparities in the quality of care. A report from the Institute of Medicine documented that black individuals and members of other minorities face considerable challenges in the receipt of high-quality care.<sup>77</sup> The report found that, for virtually all therapeutic interventions, ranging from high-technology procedures to the most elementary forms of diagnostic and treatment interventions, members of minorities receive fewer procedures and poorer medical care than do white individuals. These racial differences in the quality and intensity of care received persisted even after adjustment for SES, insurance status, stage and severity of disease, comorbidity, and type of medical facility.

Studies on asthma have repeatedly found that members of minorities are less likely to receive appropriate asthma medications for preventive care or treatment of acute exacerbations.<sup>78–81</sup> For example, Finkelstein et al<sup>79</sup> found that young children of racial minorities who were admitted because of asthma exacerbations were less likely than white patients to have taken antiinflammatory medications and were much less likely to be prescribed a nebulizer for home use at discharge. Another study found that black and Hispanic children received fewer  $\beta_2$ -adrenergic receptor agonists and Hispanic children received fewer inhaled corticosteroids (ICSs) than did white children, after adjustment for a range of potential confounders.<sup>78</sup> In addition, investigations of federally funded community health centers and inner-city hospitals reported significant levels of noncompliance with the National Asthma Education and Prevention Program guidelines for recommended care, including underuse of ICSs, peak flow meters, spacers, and written action plans.<sup>82,83</sup> For example, 1 study found that only 14% of community health centers followed the National Asthma Education and Prevention Program guidelines of having a documented asthma management plan and only 27% performed asthma severity assessments.<sup>83</sup>

### Segregation and Collective Efficacy

Finally, the concentration of social disadvantage linked to segregation has degraded not only physical and material resources but also social and communal resources

historically used by black communities. Researchers have noted the adaptive capacity of black individuals to use indigenous community resources, such as informal control, collective efficacy, and community empowerment, to survive years of oppression.<sup>9,16,52,84–86</sup> For example, in their examination of differences in resource networks and experiences of community life in black and white communities, Mitchell et al<sup>85</sup> found that, in the absence of formal community resources, members of the black community relied more heavily on informal resource networks to meet their needs.

Residential segregation and the increasing concentration of poverty in recent decades has led to unprecedented areas of concentrated disadvantage, where lower-income, minority, and single-parent residents are isolated from key resources that support collective social control. The resulting racial and economic exclusion has produced a decline of social control and an increase in violent crime.<sup>16,28,29,87,88</sup> This undermining of community resiliency and social cohesion has implications for asthma. Collective efficacy has been shown to be protective of asthma and other breathing problems,<sup>89</sup> perhaps by facilitating health-promoting communication, eliminating environmental hazards, and reducing stress through social support networks. In contrast, areas of high mistrust are associated with a tendency to remain indoors, leading to asthma-inducing risk factors such as increased allergen exposure, a sedentary lifestyle, and social isolation.<sup>30</sup> Segregation that results in a “socially toxic” neighborhood environment can exact a physical toll on residents that leaves them vulnerable to asthma.

## IMPLICATIONS OF SEGREGATION FOR CHILDHOOD ASTHMA

### Health Care Delivery Implications

The social determinants of childhood asthma have important implications for the effective delivery of medical care, as well as future research on asthma. In the delivery of care and the treatment of asthma, health care providers must take the social context seriously. A study of trends over time highlights the importance of redoubling efforts to ensure that poor and minority children receive the appropriate treatment for asthma; between 1989 and 1996, the gap in the use of ICSs narrowed for black individuals, compared with white individuals, but did not change for Hispanic individuals.<sup>90</sup> In addition, minority patients and children experienced a slower increase in the number of ICS prescriptions during that time period. Moreover, minority children had the smallest increase in prescribed ICSs and were still disadvantaged in 1996. These data suggest that the use of prescribed ICSs may still be too low in the minority patient population, given that asthma is more prevalent and more severe in this population.

Studies of asthma education interventions for low-income, inner-city children and their families have documented the need to address multiple contextual and psychosocial issues not targeted by more-traditional educational or asthma intervention programs such as the Neighborhood Asthma Coalition and Asthma Coach programs in St Louis, Missouri.<sup>91</sup> This need is often



brought to investigators' attention through anecdotal reports from nurse home visitors and educators, as well as research field staff members. Reflecting the emphasis on the complex and diverse relationships among community-level factors and the pathways of their impacts, both the Neighborhood Asthma Coalition and the Asthma Coach programs reported the need to address topics that might seem to have little pertinence to asthma management.<sup>2</sup> Reflecting the diverse stressors that may undermine asthma management, the Asthma Coaches worked with parents not only on key asthma management practices but also on the stressors in their lives, including problems with landlords or welfare benefits, domestic disputes, and community violence; they also addressed safety issues so that participants could attend planned community education programs on asthma and could seek employment. In a breastfeeding intervention study among mothers in Baltimore, Maryland, who were enrolled in the Supplemental Nutrition Program for Women, Infants, and Children, interviewers also discovered a preoccupation with issues of personal safety among black mothers living in neighborhoods with high levels of crime and violence.<sup>92</sup> Some participants indicated that they considered breastfeeding impractical because their everyday lives were full of danger and they were very concerned about their safety. Notably, breastfeeding may be an important protective factor related to asthma morbidity.<sup>93</sup> This example highlights the multiple intertwined pathways through which social conditions can influence asthma risks.

A model that has been shown to be effective in improving the care of low-income children in general, including the management of asthma, is the Medical-Legal Partnership for Children developed by Boston Medical Center.<sup>94</sup> This model has integrated on-site lawyers into the network of specialists to whom primary care providers can refer their patients. Laws and regulations that foster the health and safety of children and that can facilitate the management of childhood asthma are not implemented uniformly. More than one half of poor and moderate-income families face serious civil and legal challenges, which often are not perceived as legal issues. The addition of lawyers to the medical team can promote health, prevent disease, and address barriers to the effective care of asthma through screening of patients and their families for social problems that can affect asthma management, assistance with the resolution of specific social problems, and enhancement of the effectiveness of advocacy by the entire health care team. This team includes physicians and social workers and ensures that patients receive all of the needed services to which they are entitled. The Medical-Legal Partnership for Children has enhanced the medical center's ability to address patient stressors in the areas of housing, immigration, income support, health insurance, education access, and disability and family law by thwarting the illegal denial of various benefits and helping patients navigate the intricacies of bureaucratic regulations, which have shifted in recent years from an emphasis on helping families to one of preventing fraud.

## Research Implications

There are important research implications related to the distinctive residential environments in which socially disadvantaged children live. A research approach that focuses on the relationships of individual risk factors to asthma is unlikely to capture the complex multidimensional factors that contribute to the variations in asthma prevalence and morbidity rates. Research that incorporates a life-course, cumulative, risk perspective and that seeks to determine how multiple risks and resources linked to the individual, family, housing, neighborhood, and societal levels relate to each other and combine to affect childhood asthma is needed. Researchers also need to address seriously the extent to which distinct residential environments can affect normal physiological processes. Biological adaptations to these residential environments might lead to biological profiles that are different for persons residing in deprived residential areas and possibly to distinctive patterns of interactions between biological and psychosocial factors for black individuals. Importantly, this suggests that the observation of distinctive biological profiles is not necessarily reflective of inherent genetic differences but might partly reflect adaptations to unique residential environments.

Research on the role of residential conditions clearly suggests that a strategy for improving asthma outcomes on a long-term basis requires policies and interventions that focus on improving the quality of housing and neighborhood conditions for poor children in general and for minority children in particular. That is, policies to reduce social disparities in asthma and in other health outcomes need to address the factors that coincide with segregation, including the concentration of economic disadvantage and the lack of an infrastructure that promotes opportunity. Eliminating the negative effects of segregation on SES, neighborhood conditions, and asthma is likely to require a major infusion of economic resources to improve the social, physical, and economic infrastructure of disadvantaged communities. It is important to recognize that nothing is inherently negative about living in close proximity to persons of one's own race. The issue is not segregation per se but the accumulation of social problems that coincide with the concentration of poverty in high-segregation areas in the United States.

## CONCLUSIONS

The research reviewed suggests that the distribution of asthma according to race and SES is created by larger inequalities in society, of which residential segregation (an institutional legacy of racism) is one determinant. Future research must seek to understand how innate and acquired biological factors interact with conditions in the psychological, social, and physical environments to affect asthma risks and the patterns of asthma distribution. At the same time, elimination of disparities in asthma and asthma care requires acknowledgment and documentation of the health consequences of social policies and development of the political will and commitment to implement new strategies to ameliorate the

negative effects of these policies, by dismantling the structures of racism that created them and establishing programs and strategies that can counteract the pervasive negative effects of institutional discrimination on health. The care of children with asthma can play an important role in this regard, by addressing the social determinants of their health as part of the delivery of medical care.

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## Social Determinants: Taking the Social Context of Asthma Seriously

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