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The Association between Parental Perception of Neighborhood Safety and Asthma Diagnosis in Ethnic Minority Urban Children

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ABSTRACT *Low-income populations, minorities, and children living in inner cities have high rates of asthma. Recent studies have emphasized the role of psychosocial stress in development of asthma. Residence in unsafe neighborhoods is one potential source of increased stress. The study objective was to examine the association between parental perception of neighborhood safety and asthma diagnosis among inner city, minority children. Cross-sectional data from a community-based study of 6–8-year-old New York City children were used. Asthma was defined as parental report of physician-diagnosed asthma and at least one asthma-related symptom. Parental perceptions of neighborhood safety were assessed with a questionnaire. Associations between perceived neighborhood safety and asthma were examined using chi-squared tests. Multivariate logistic regression analyses were then performed. Five hundred four children were included with 79% female, 26.5% non-Hispanic Black, and 73.5% Hispanic. Asthma was present in 23.8% of children. There was an inverse association between feeling safe walking in the neighborhood and asthma with 45.7% of parents of asthmatic children reporting they felt safe compared to 60.9% of parents of non-asthmatic children ($p=0.006$). Fewer parents of asthmatic children than of non-asthmatic children reported that their neighborhood was safe from crime (21.7% versus 33.9%, $p=0.018$). In multivariate analyses adjusting for race/ethnicity, age, gender, socioeconomic status, number of smokers in the home and breastfeeding history, parents reporting feeling unsafe walking in the neighborhood were more likely to have a child diagnosed with asthma (OR=1.89, 95%CI 1.13–3.14). Psychosocial stressors such as living in unsafe neighborhoods may be associated with asthma diagnosis in urban ethnic minority children. Addressing the increased asthma burden in certain communities may require interventions to decrease urban stressors.*

KEYWORDS *Asthma, Neighborhood, Urban, Safety, Children*

INTRODUCTION

Asthma

Asthma is a chronic, inflammatory lung disease characterized by symptoms of cough, wheezing, dyspnea, and chest tightness that occur in paroxysms and are

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usually related to specific triggering events. An estimated 9.6 million children (13.1%) under the age of 18 have been diagnosed with asthma during their lifetimes, based on 2007 data from the Centers for Disease Control and Prevention.[1] The prevalence of childhood asthma has increased dramatically over the past few decades in the United States.[2]

Low-income populations and children living in inner cities have higher morbidity and mortality due to asthma. According to New York City Department of Health data, the child asthma hospitalization rate is about double the national rate with significant disparities among neighborhoods.[3] Of 1982 children screened by the Harlem Children's Zone Asthma Initiative, 28.5% were told by a doctor or nurse that they had asthma and 30.3% had asthma or asthma-like symptoms.[4] In addition, there are racial/ethnic disparities in asthma with prevalence being higher in African American and Hispanic children.[5] Among Hispanics, Puerto Rican children have especially high risk.[6–8]

According to consensus statements by the Institute of Medicine[9] and the National Institute of Environmental Health Sciences[10], examining disparities in environmental health requires attention to both environmental and social conditions. Physical characteristics of neighborhood and housing environments such as air pollution, mold and pests may not fully account for disparities in asthma. Social factors such as stress levels and caregiver mental health may also play an important role. A number of review articles and observational studies have commented on associations between stress and asthma.[11–16] In addition, in the National Cooperative Inner-City Asthma Study, including 1,528 urban asthmatic children ages 4–9 years, 50% of caretakers reported clinically significant levels of psychological distress and caretaker's mental health was the strongest predictor of asthma hospitalizations.[17]

Residence in unsafe neighborhoods may be one potential source of chronic stress.[18,19] Only one study has specifically examined the relationship between neighborhood safety and asthma diagnosis. The study, published in 2009, used data from the National Survey of Children's Health.[20] One general question was used to assess perceived neighborhood safety, which was "How often do you feel (child) is safe in your community or neighborhood?" The study found higher reported lifetime asthma in children living in neighborhoods perceived to be sometimes or never safe compared to living in neighborhoods that were perceived to be always safe.

The goal of this study was to examine the association between different measures of parental perception of neighborhood safety and asthma diagnosis in a group of urban ethnic minority children.

METHODS

Study Design and Participants

The Growing Up Healthy study is a community-based epidemiologic study including 504 6- to 8-year-old New York City children enrolled in 2004–2007. Female participants were recruited as part of a multicenter study in three U.S. cities to describe risk factors for early onset of puberty in a cohort of girls.[21] Boys were recruited as part of a parallel study, Growing Up Healthy in East Harlem, which is examining the effects of neighborhood characteristics and chemical exposures on growth and development of East Harlem girls and boys.[22] Because the primary outcome in the larger study is onset of puberty in girls, there are more girls ($n=399$)

than boys (n=105) in the study. English and Spanish speaking children were recruited as per an institutional review board–approved protocol from an academic primary care pediatric practice, community health centers, and schools. Written consent was obtained from parents and witnessed assent was obtained from children.

Measurements

Outcome Measurement. Several short questionnaires have been validated for the detection of asthma in children. One such tool is the brief pediatric asthma screen (BPAS).[23] 129 low-income minority parents of children aged 6 to 12 in three public schools in Chicago participated in the validation of this screen compared to the gold standard of evaluation by an expert in asthma. For asthma, the best items were wheeze, persistent cough, night cough, and response to change in air temperature. The simplest scoring, any one of the four items, yielded the best balance of specificity (73.6%) and sensitivity (73.3%). In our study, we asked families about the four asthma symptoms used in the BPAS. We also asked about physician-diagnosed asthma with the question "Has a doctor or nurse ever said that (CHILD'S NAME) has asthma?" This question has been used in large epidemiologic studies such as The National Health and Nutrition Examination Survey. In this study, a child was defined to have asthma if there was a positive BPAS score (a positive response to at least one of four asthma symptom questions) and a report of physician- diagnosed asthma. Parents of asthmatic children also reported on use of asthma controller medications (including inhaled corticosteroids with or without long acting beta agonists and/or leukotriene receptor antagonists).

Main predictor variables. Parental perceptions of neighborhood safety were assessed with a questionnaire. Yes/no questions were asked about six different factors: (1) sidewalks being in good condition, (2) perceived child safety when walking in the neighborhood, (3) adequacy of street lighting, (4) neighborhood safety from crime, (5) influence of safety concerns on child's outdoor play, and (6) influence of traffic concerns on child's outdoor play.

Covariates. The main covariates of interest included age, gender, socioeconomic status, race/ethnicity, presence of smokers in the child's home and whether the child had breastfed. Socioeconomic status was measured using level of parental education, type of health insurance, languages spoken in the home, number of people per room in the home and residence in East Harlem. Race/ethnicity was derived using information given about national origin of each child's parents and grandparents. Any child described as Hispanic/Latino(a), was placed in one of the Hispanic subgroups. Children whose parents or grandparents were born in a Spanish speaking country other than Mexico, the Dominican Republic or Puerto Rico, or who were not born in the same country were categorized as "other/mixed Hispanic". Children whose parents or grandparents were not identified as Hispanic and were identified as Black were categorized as "non-Hispanic Black".

Additional variables of interest included measures of obesity, physical activity and sedentary activity. Interviewers were trained and certified to measure weight and standing height using standardized protocols.[24] The SAS program from the U.S. Centers for Disease Control and Prevention was used to calculate body mass index (BMI) percentiles based on the 2000 CDC growth charts for children 0 to 20 years of age.[25] Children with BMI $\geq$5th and <85th percentile were classified as "normal

weight", with BMI ≥85th and <95th percentiles were classified as "overweight" and with BMI ≥95th percentile were classified as "obese". Participation in various activities was reported (hours per week and months per year). Metabolic equivalent (MET) values assigned to each type of activity[26] were then used to convert to MET-hours per week of moderate to vigorous activity averaged over the year. Time spent each day in sedentary activities was also reported in the questionnaire.

Statistical analyses

Analyses were performed using SPSS, version 16.0 software (SPSS Inc, Chicago, IL). Descriptive statistics for all variables were examined for the whole group and among asthmatics and non-asthmatics. Differences between asthmatics and non-asthmatics were examined using chi-square tests. The main dependent variable was the binary variable of whether the subject had asthma based on parental report of at least one asthma symptom and physician diagnosis of asthma. Associations between perceived neighborhood safety and asthma were examined using chi-squared tests. Multivariate logistic regression analyses were then performed. Final models adjusted for age, gender, race/ethnicity, socioeconomic status, number of smokers in the home and whether the child had breastfed. Analyses were also performed with all of the above variables as well as measures of obesity, physical activity and sedentary activity. Finally, a sub-analysis including only children with asthma was performed. Among asthmatic children, the association between perceived neighborhood safety and parent-reported use of an asthma controller medication (proxy for asthma severity) was examined using chi-squared tests.

RESULTS

Overall, 79.2% of the participants (n=504) were female and there were almost equal numbers of children at ages 6, 7, and 8 years (see Table 1). Of all children with complete ancestry information (n=486), 27.6% were described as Non-Hispanic Black and the remainder were classified as one of the Hispanic subgroups or as other/mixed Hispanic. In terms of socioeconomic status, over 60% of families reported highest parental education level in the home as high school or less. In addition, most families had government health insurance and had a household income of less than $50,000 per year (with 54% reporting incomes below $25,000 per year).

There was parental report of physician-diagnosed asthma in 26% of children. In terms of symptoms, 28.2% of all parents reported "ever wheeze", 22.0% reported "persistent cough", 30.4% reported "night time cough" and 23.9% reported "breathing problems with temperature changes". A child had a positive BPAS score (BPAS 1+) if parents reported presence of any one of these four symptoms (50.6%). Asthma, based on a positive BPAS score *and* parental report of physician-diagnosed asthma, was present in 23.8% of children. The vast majority of asthmatic children reported "ever wheeze" (83.3%) with somewhat fewer reporting "persistent cough" (58.3%), "night time cough" (65.8%), and "breathing problems with temperature changes" (62.2%). As expected, rates of reported symptoms among non-asthmatic children were lower and ranged from 10.7% (persistent cough) to 19.3% (night time cough). Among asthmatic children, the reported rate of use of an asthma controller medication was 21.7%.

In bivariate associations between participant characteristics and asthma diagnosis (see Table 1), there was no significant association with gender or age. Associations

TABLE 1 Descriptive characteristics for 6–8-year-old ethnic minority NYC children (all children ($n=504$), asthmatics ($n=120$) and non-asthmatics ($n=384$))

Characteristic (Total N)	N (%)	Asthmatics	Non-Asthmatics	p value[b]
BPAS 1+ and physician asthma ($N=504$)	120 (23.8%)			
Ever wheeze ($N=503$)		100 (83.3%)	42 (11.0%)	<0.001
Persistent cough ($N=504$)		70 (58.3%)	41 (10.7%)	<0.001
Night time cough ($N=504$)		79 (65.8%)	74 (19.3%)	<0.001
Symptoms temp change ($N=503$)		74 (62.2%)	46 (12.0%)	<0.001
Gender ($N=504$)				
Female	399 (79.2%)	91 (75.8%)	308 (80.2%)	0.303
Male	105 (20.8%)	29 (24.2%)	76 (19.8%)	
Age ($N=504$)				
6 years	194 (38.5%)	51 (42.5%)	143 (37.2%)	0.460
7 years	159 (31.5%)	38 (31.7%)	121 (31.5%)	
8 years	151 (30.0%)	31 (25.8%)	120 (31.3%)	
Ethnicity[a] ($N=486$)				
Mexican	143 (29.4%)	16 (14.2%)	127 (34.0%)	<0.001
Dominican	41 (8.4%)	7 (6.2%)	34 (9.1%)	
Puerto Rican	100 (20.6%)	38(33.6%)	62 (16.6%)	
Other/Mixed Hisp	68 (14.0%)	18 (15.9%)	50 (13.4%)	
Non-Hisp Black	134 (27.6%)	34 (30.1%)	100 (26.8%)	
Parental education ($N=494$)				
Less than high school	178 (36.0%)	41 (35.0%)	137 (36.3%)	0.826
High school grad or GED	122 (24.7%)	26 (22.2%)	96 (25.5%)	
Some college	135 (27.3%)	35 (29.9%)	100 (26.5%)	
College grad or higher	59 (11.9%)	15 (12.8%)	44 (11.7%)	
BMI percentile category ($N=503$)				
Under/normal weight (<85th%ile)	292 (58.1%)	60 (50.0%)	232 (60.6%)	0.114
Overweight (85th to <95th%ile)	78 (15.5%)	21 (17.5%)	57 (14.9%)	
Obese (≥95th%ile)	133 (26.4%)	39 (32.5%)	94 (24.5%)	
Ever breastfed ($N=501$)				
Yes	351 (70.1%)	72 (60.5%)	279 (73.0%)	0.009
No	150 (29.9%)	47 (39.5%)	103 (27.0%)	
Smokers in home ($N=504$)				
0	327 (64.9%)	66 (55.0%)	261 (68.0%)	0.009
1	125 (24.8%)	34 (28.3%)	91 (23.7%)	
2+	52 (10.3%)	20 (16.7%)	32 (8.3%)	

[a]Only reported for children with full Hispanic/Latino ancestry information available for child's mother and father
[b]Chi-squared test of proportions in asthmatics and non-asthmatics

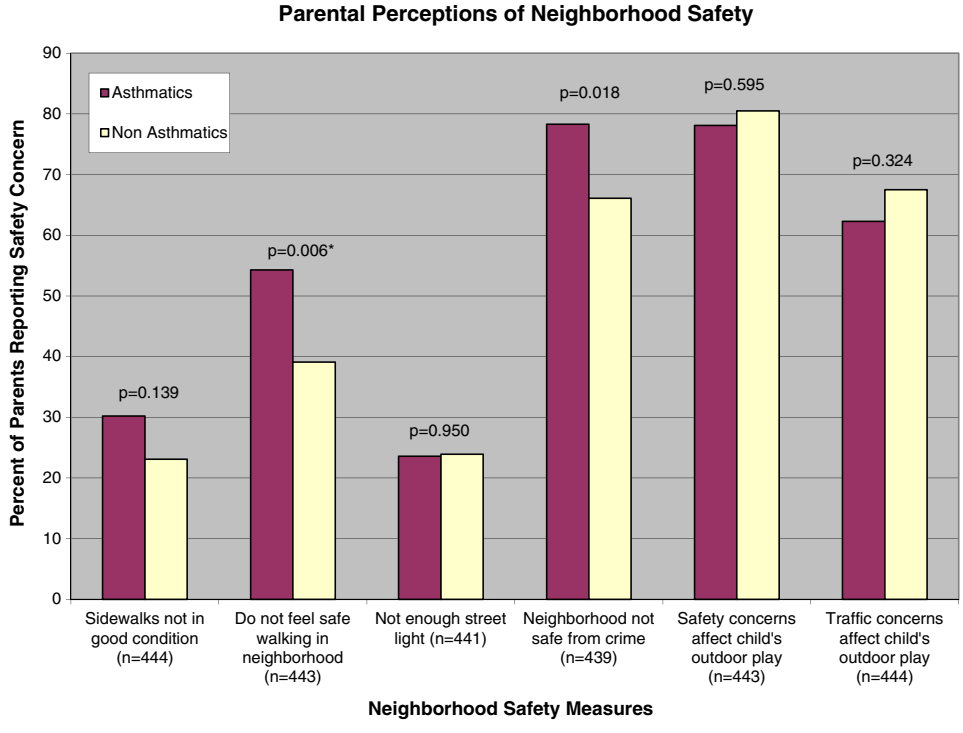
with race/ethnicity were examined only for children with full Hispanic/Latino ancestry information available for the child's mother and father ($n=486$). More children with asthma were identified as Puerto Rican and less were identified as Mexican compared to children without asthma ($p<0.001$). There were no associations between socioeconomic factors and asthma diagnosis (only data for parental education shown). There was a trend towards higher rates of overweight and obesity among asthmatics (17.5% and 32.5%, respectively) than among non-asthmatics (14.9% and 24.5%, respectively; $p=0.11$). We have previously shown an association between different measures of obesity and asthma diagnosis in this group of children.[27] The percent of parents reporting having "ever breastfed" was

lower among asthmatics (60.5%) than non-asthmatics (73.0%; $p=0.009$). There were also more smokers in the homes of asthmatic children (16.7% of homes with two or more smokers) than in the homes of non-asthmatic children (8.3% of homes with two or more smokers; $p=0.009$).

Figure 1 includes descriptive data related to parental perceptions of neighborhood safety for asthmatic and non-asthmatic children. When examining data for all children combined, a vast majority of parents (80%) reported that safety concerns affect their child's outdoor play. Almost 70% of parents reported that their neighborhood is not safe from crime and that traffic concerns affect outdoor play. Forty three percent said they do not feel safe walking in their neighborhood. Fewer (about 25%) reported sidewalks not being in good condition or not having enough street light.

There was a significant association between feeling safe walking in the neighborhood and asthma with only 45.7% of parents of asthmatic children reporting they felt safe compared to 60.9% of parents of non-asthmatic children ($p=0.006$). Fewer parents of asthmatic children than of non-asthmatic children reported that their neighborhood was safe from crime (21.7% versus 33.9%, $p=0.018$). There was no association between other neighborhood safety factors and asthma diagnosis or between general description of neighborhood appearance (very pleasant, somewhat pleasant, not very pleasant, not at all pleasant) and asthma diagnosis.

In multivariate analyses adjusting for race/ethnicity, age, gender, socioeconomic factors, number of smokers in the home and whether the child had breastfed, parents reporting feeling unsafe walking in the neighborhood were more likely to have a child diagnosed with asthma (OR=1.89, 95% CI 1.13–3.14 $p=0.015$; see Table 2). The only other variable significantly associated with asthma diagnosis in



*p value for Chi Square test comparing proportions of parents of asthmatic and non-asthmatic children reporting safety concerns

FIGURE 1. Parental perceptions of neighborhood safety.

TABLE 2 Multivariable models—association between neighborhood safety measures and asthma diagnosis

	Asthma versus no asthma OR (95% CI)
Safe sidewalks ($N=413$)	
Yes	1.00
No	1.31 (0.74–2.32)
Feel safe walking in neighborhood ($N=412$)	
Yes	1.00
No	1.89 (1.13–3.14)
Adequate street light ($N=410$)	
Yes	1.00
No	0.98 (0.54–1.79)
Neighborhood safe from crime ($N=409$)	
Yes	1.00
No	1.55 (0.86–2.80)
Safety concerns affect outdoor play ($N=413$)	
Yes	1.00
No	0.78 (0.43–1.39)
Traffic concerns affect outdoor play ($N=413$)	
Yes	1.00
No	1.08 (0.64–1.83)

All models included age in months, gender, race/ethnicity, highest level of parental education in the home, number of people per room in the home, whether the family lived in East Harlem, type of health insurance, language spoken in the home, whether the child ever breastfed and number of smokers in the home. Note about missing data: 18 children did not have full Hispanic/Latino ancestry information available for the child's mother and father and thus could not be placed into one of the race/ethnicity subgroups. We did not have highest level of parental education in the home for ten children. Language(s) spoken in the home was missing on four children and breast feeding information was missing on two children. The final *N* for each model reflects all above missing data plus missing data for each individual neighborhood safety measure

multivariate models was race/ethnicity. Puerto Rican, other/mixed Hispanic and non-Hispanic Black children were more likely to be diagnosed with asthma compared to Mexican children. Additional models adjusting for weight status, amount of recreational physical activity and levels of sedentary activity did not alter estimates for the neighborhood safety variable significantly (less than 10% change). In a sub-analysis including only children with asthma, there was no association between perceived neighborhood safety and reported use of a controller medication.

DISCUSSION

Our study is one of the first to document an association between parental perception of neighborhood safety and asthma diagnosis in urban ethnic minority children. The previous study by Subramanian et al. examined the association of perceived neighborhood safety and reported asthma diagnosis using information from a national data set that included primarily non-Hispanic white children (67.5%) of higher socioeconomic status. Our study, on the other hand, included only ethnic minority urban children from mostly low socioeconomic status backgrounds.

Perceived neighborhood safety may be linked with higher stress levels through chronic exposure to violence.[28] Individuals in neighborhoods with routine exposure

to violence may be under stress related to perceived lack of safety for themselves or their family members. This stress could in turn be related to increased prevalence or morbidity from illnesses such as asthma. Potential mechanisms for the link between stress and asthma include altered innate and adaptive immune responses, IgE expression, eosinophil activity, allergen-induced proliferative responses, altered neuroimmune responses and increased cytokine expression.[29–34]

In this study, the neighborhood safety factors which appear to be most strongly associated with asthma diagnosis are feeling safe walking in the neighborhood and neighborhood safety from crime. Both of these factors may be directly linked to community exposure to violence. Other safety factors not related to violence such as condition of sidewalks, street lighting, and traffic were not associated with asthma in our study. Report of safety concerns affecting child's outdoor play was also not associated with asthma, which could be related to parents interpreting "safety" in this question as related to traffic or other concerns and not to violence.

Other studies have also found associations between levels of community violence and asthma. One study[35] found increased child asthma risk with medium and high levels of community violence compared to low levels of violence, controlling for individual level demographics and neighborhood social characteristics. Another study found that increased frequency of exposure to violence predicted a greater number of asthma symptom days, even after controlling for socioeconomic status and housing conditions.[36] A follow-up study found an elevated risk of asthma with increase in nitrogen dioxide exposure only among children with higher levels of exposure to violence.[37] This implies that there may be an interaction between toxic exposures and exposures to violence, both of which have been shown to be higher in low-income urban neighborhoods. There may be similar interactions between known environmental asthma triggers such as indoor allergen or air pollutant exposures and chronic stressors such as community violence and unsafe neighborhoods. These environment and stress interactions need to be studied further.

One potential limitation of this study is that we used parental report of asthma symptoms and physician-diagnosed asthma as our main asthma outcome. Other possible asthma outcomes include more objective measures such as pulmonary function testing and methacholine challenge testing. However, report of physician-diagnosed asthma has been used widely as a measure of asthma diagnosis in large epidemiologic studies such as the National Health and Nutrition Examination Survey.[38] The BPAS was validated in an urban, ethnic minority community similar to ours. Use of a positive BPAS score *and* report of physician-diagnosed asthma is a more conservative estimate of asthma prevalence than use of either of these methods alone. Furthermore, rates of asthma in our study (including high rates among Puerto Rican children) are consistent with other local estimates of asthma prevalence using more detailed measures for asthma diagnosis.[4,39] The reasons for higher asthma rates in certain ethnic minority groups are currently unclear and more work must be done to clarify if the increased risk is genetic, environmental or a combination of the two. Finally, reported use of an asthma controller medication, which might be a proxy for more persistent or severe asthma, was low in this study. This might partly explain the lack of association between perceived neighborhood safety and controller medication use among asthmatic children. However, we did not have complete information about asthma severity classification to determine if there were actually low rates of persistent/severe asthma versus under prescribing or underuse of controller medications.

Another important limitation of this study is that cross-sectional data were used, making it impossible to make conclusions about causality. Parents with asthmatic children might be moving to unsafe neighborhoods rather than unsafe environments causing asthma. While we were able to control for several potential factors which may be related to both asthma and neighborhood characteristics, including demographic variables, socioeconomic factors, environmental factors and lifestyle factors, there may still be residual confounding. One especially important potential confounder is socioeconomic status as it has been linked to both neighborhood conditions and asthma prevalence. Interestingly, in our study there was no association between asthma diagnosis and measures of socioeconomic status (as measured by level of parental education, type of health insurance, languages spoken in the home or number of people per room in the child's home). It is possible that such relationships were not present in this study because the population was predominantly one of low income, and there might not be enough variability in socioeconomic factors to show differences in asthma rates. Other important potential confounding factors which were not measured in our study include parent health status, psychological measures including depression/anxiety, toxin/allergen exposures, housing quality and access to health care.

Another consideration is that the main exposure variable (neighborhood safety) was measured using questions assessing parental perceptions of various neighborhood characteristics instead of observed or objectively measured neighborhood safety indicators. However, the vast majority of the children in the study live in the same or similar neighborhoods and the true neighborhood safety is likely to be relatively equivalent. Thus it is actually the parents' *perception* of safety that varies. This could be a strength of the study, as effects of safety on outcomes might well be related to how individuals perceive or react to their environment as opposed to actual quantified level of safety. Clearly more data related to specific psychological and stress measures, violence exposure and other objective safety measures are needed to better understand these relationships.

In conclusion, psychosocial stressors such as living in unsafe neighborhoods may be associated with asthma. This was the first study to our knowledge that included several questions about perceived neighborhood safety and included a large sample of mixed ethnic minority children living in urban neighborhoods. Addressing the increased asthma burden in certain communities may require interventions to decrease urban stressors and improve "socially toxic" environments. Future studies could include longitudinal studies with baseline measurement of neighborhood characteristics, stress markers, psychological measures and environmental exposures.

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