Social and environmental determinants of asthma among U.S. urban children

A DISSERTATION

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By Elizabeth W. Holt, MPH

Dissertation Committee
Felicia Rabito, MPH, PhD*
Katherine Theall, PhD
Janet Rice, PhD
Tom Farley, MD, MPH

**committee chair*

ProQuest LLC.
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106 - 1346

Abstract

Childhood asthma disparities have been repeatedly shown to exist within the United States, with urban, minority children experiencing asthma at much higher rates than their suburban counterparts. This increased burden of asthma among poor and minority children living in urban areas is likely due to a myriad of factors, including lack of regular access to preventive care, lack of adherence to anti-inflammatory medications, and increased exposure to allergens, irritants (cigarette smoke and outdoor air pollution), respiratory infections, and psychological stressors. In addition, the social environment within which a child lives may also play a role in the increased episodes of asthma seen among U.S. urban youth.

Importantly, some urban neighborhoods have higher rates of asthma than others, and some individuals living within urban neighborhoods are more likely to suffer from episodes of severe asthma than others. A closer analysis of *which* characteristics in the urban environment are important risk factors for asthma is warranted, with careful examination of the relative importance of individual and neighborhood characteristics. To date, it remains unclear (1) what specific characteristics put some urban children at greater risk for asthma than others, (2) the extent to which asthma varies by urban neighborhoods 3) what neighborhood characteristics are associated with the induction or exacerbation of asthma in children, and (4) whether individual level characteristics have a greater impact on asthma risk than the effects of the neighborhoods that children live in.

The overall goal of this dissertation is to explore factors in the physical, social, and psychosocial environment which are associated with asthma in U.S. urban children. In *manuscript 1*, I examine the relationship between economic disadvantage and asthma, and the relative influence of individual land neighborhood factors. In *manuscript 2*, I examine the relationship between psychosocial stressors and ER utilization for asthma. In *manuscript 3*, I examine the relationship between Child's BMI, staying indoors due to neighborhood violence, and report of having an asthma attack.

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Table of Contents

Prospectus

Results of 3 Manuscript Model

Chapter 1: Background and Literature Review

1.I. Background

Asthma, an inflammatory condition of the airways, is the leading serious chronic illness of children in the U.S : in 2006, an estimated 6.8 million U.S. children under age 18 (almost 1.2 million under age 5) currently had asthma[1]. Asthma is the third-ranking cause of hospitalization among those younger than 15 years of age and accounts for 14 million lost days of school missed annually. A body of research has shown that asthma prevalence, morbidity, and mortality is disproportionately shouldered by socially disadvantaged populations, particularly among minority children living in low-income urban areas[2-8]. This increased burden of asthma among poor and minority children living in urban areas is likely due to a myriad of factors, including lack of regular access to preventive care, lack of adherence to anti-inflammatory medications, and increased exposure to allergens, irritants (cigarette smoke and outdoor air pollution), respiratory infections, and psychological stressors [9-11] Some studies have also shown that variations in asthma can't completely be explained by individual level factors: forces acting at the neighborhood level (neighborhood crime, vacant housing) appear associated with asthma morbidity above and beyond individual level influences [10, 12-17] .

Both the large social environment, and an individual's socioeconomic status have consistently shown to be associated with morbidity and mortality across a wide range of diseases[18]. The social environment that a child lives within appears to be important in asthma too: the neighborhood or community in which a child lives has consistently

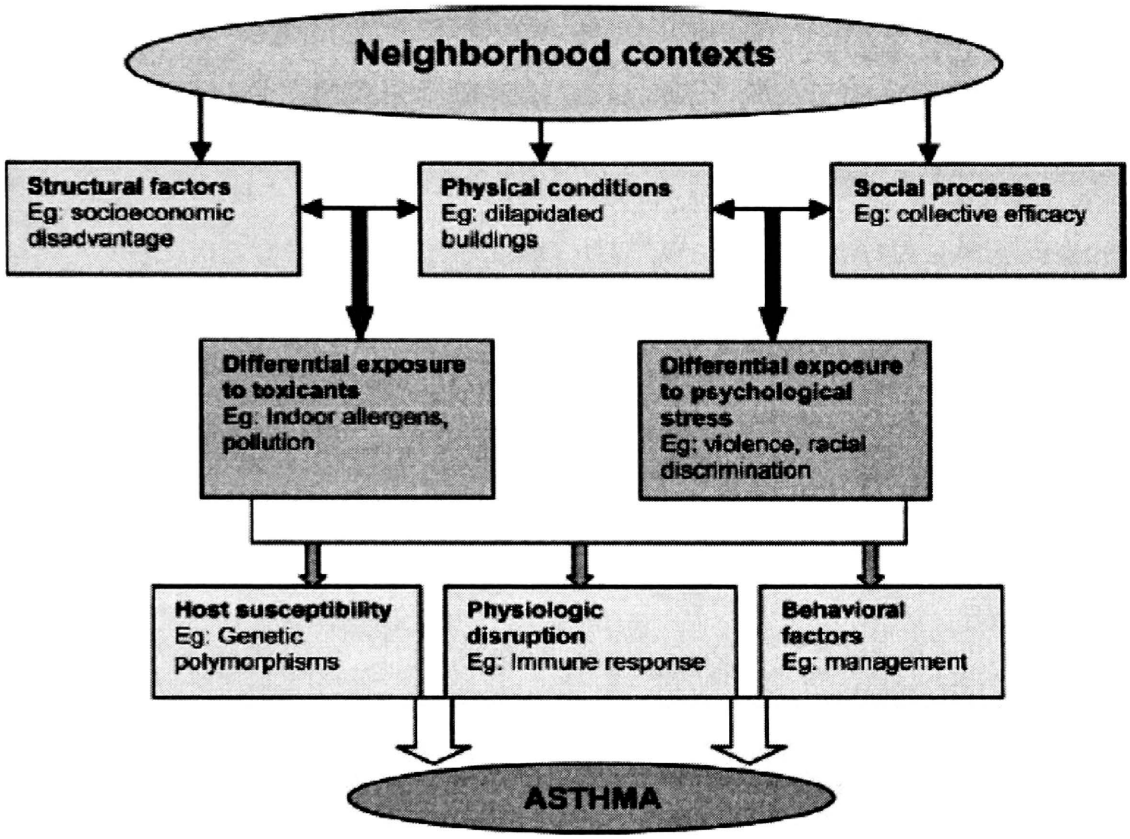
emerged as a significant predictor of asthma prevalence in a number of settings.[19-21] *Place* - residing in an impoverished urban area - may be an important factor driving asthma disparities. Studies of geographical variation in asthma prevalence have shown that asthma rates differ both between large cities and among neighborhoods within the same large cities.[9, 22] This may simply be because some neighborhoods have a greater proportion of at-risk children or risk factors (i.e. endogenous factors: these children and their families select into these areas). However, an alternative explanation is that community level physical and social exogenous factors may be directly contributing to the development and exacerbation of asthma through contextual forces such as socioeconomic disadvantage and physical conditions, and measures of collective efficacy[17, 19, 23].

Traditional study of the relationships between risk factors and disease outcomes has been focused primarily at the individual level. However, a growing number of epidemiologists have begun to argue for an expansion of the one exposure one outcome model of causation, and examine individual risk factors within the context of the groups and social structures that shape them[23]. Epidemiologists Dana Loomis and Steve Wing write that, a cause or risk factor for disease should be thought of "not as a property of agents, but one of systems in which the population phenomena of health and disease occur"[24]. Literature from the field of sociology has long been documenting group level influences on individual behavior such as educational attainment [25], and life satisfaction[26]. The emergence of multi-level modeling techniques in health research has allowed epidemiologists to examine the complex interplay between the individual and the

contextual world in which they live, and allow for consideration of contextual effects – the effects of group-level properties on individual level outcomes. Modeling individual and group effects simultaneously allows for the separation of different sources of variation, and the quantification of the relative importance of individual and neighborhood differences in explaining variation in health outcomes. Importantly, multi-level models can show not only whether variations exist between neighborhoods or groups, but also whether these variations are associated with individual effects, contextual effects, or both.

The factors thought to be influencing rates of asthma in the inner-city are closely intertwined, and more work is needed to separate out which factors present in the urban environment could be driving the excess burden. It appears that an individual's risk for asthma has multi-level determinants – influenced by the social context in which a child lives. Models which incorporate the multi-level nature of asthma risk factors are needed in order to tease apart the different risk factors for asthma. Figure 1 shows a proposed theoretical framework for modeling variation in asthma outcomes which incorporates an ecological perspective of disease. For example, the model shows that factors related to asthma such as lack of asthma management or disrupted immune response can be affected by psychological stress, and this stress can in turn be either worsened or buffered by forces acting at the neighborhood or community level.

Figure 1: A multilevel approach including an ecological perspective to explain heterogeneities in asthma expression across socioeconomic and geographic boundaries.[17]



1.II. Literature Review

1.II.A. Ethnicity, economic disadvantage, and asthma

Ethnicity and measures of economic disadvantage have consistently emerged as predictors of asthma diagnosis and severity in the United States. Numerous studies have shown that minority children living in poverty have higher rates of doctor-diagnosed asthma and asthma-related health care use when compared to both other urban children and to children living in moderate and high-income neighborhoods.[2-8] In 2000, the asthma attack prevalence rate for black children was 44% higher than that of non-

Hispanic white children[27]. In addition, asthma rates are also increasing by an average of 4.3% per year[27, 28], and these increases have been most dramatic among very young (< age 5), poor, and minority children. For example, between 1981 and 1999, hospitalization rates for asthma increased 25% among black children and 11% among white children. Table 1 highlights both the increase in asthma hospitalizations over time, as well as the disparities in asthma hospitalizations between black and white children[27].

TABLE 1. Average Annual Asthma Hospitalizations (per 10 000) Among Children Younger Than 18 Years, Selected Years 1980 to 1999, U.S.

	1980–1981	1985–1986	1990–1991	1995–1996	1998–1999
Overall	21.6	26.3	29.5	31.7	26.9
Race					
White	16.0	19.0	16.7	16.5	15.5
Black	**45.5**	**48.0**	**57.6**	**71.0**	**56.9**
Age					
0–4 y	38.0	48.9	55.7	59.7	51.4
5–10 y	21.2	21.6	22.8	27.4	24.2
11–17 y	11.6	13.8	14.8	14.8	12.1

Source: National Hospital Discharge Survey, National Center for Health Statistics, Centers for Disease Control and Prevention. * All relative SEs for estimates are below 30%.

The inter-connectedness of ethnicity and poverty among the U.S. urban population make it difficult to determine whether it is ethnicity alone, economic disadvantage, or some other factor associated with these characteristics that is driving asthma disparities. There is some evidence that racial/ethnic differences only exist among the very poor, and disappear in higher income populations. Stratified analyses on 14,244 children from the 1997 National Health Interview Survey revealed that non-Hispanic black children had a higher risk of asthma than non-Hispanic white children (adjusted OR=1.99; 95% CI 1.09, 3.64); however, these differences were only seen among children from families with incomes less than half the Federal Poverty Line[29]. More work is needed to tease out the

independent roles that ethnicity and economic disadvantage play in driving asthma disparities.

There are numerous theories as to *how* ethnicity and economic disadvantage might contribute to asthma disparities. Minority children and children of socio-economically disadvantaged families use more urgent care for asthma, report less preventive care for asthma, and are more likely to show inadequate therapy for the disease. In the National Asthma Survey, a cross-sectional, national, random-digit-dial household telephone survey performed in 1998, persons reporting lower income, less education, and present unemployment, as well as smokers, were significantly ($P < 0.001$) less likely to report appropriate anti-inflammatory use than were other populations[30]. Data from the Medical Expenditure Panel Survey data from 1996 through 2000 (982 children younger than 18 years with asthma) showed that Non-Hispanic black children used more urgent care services and fewer preventive health services than the other children in the sample. Children in low-income families had the lowest levels of prescription fills and general checkups, and children whose mothers had more education had more checkups and fewer emergency department visits[31]. Clearly, economic disadvantage affects asthma outcomes through access to care. However, there are other proposed explanations for the higher prevalence of asthma among the urban poor, including environmental exposures from poor physical conditions as well as physiological stressors in the home and neighborhood environment.

1.II.B. Housing quality and the immediate physical environment

Asthma morbidity, sensitization to indoor allergens, and indoor environmental exposures have all been shown to be elevated in low-income areas, and levels of known asthma triggers such as mold, dampness, and cockroach allergens are often elevated in the deteriorated housing often found in urban environments. Cockroach allergen levels have been consistently shown to be higher in homes in areas of lower socioeconomic status than in homes with higher income areas[32-35]. Rauh *et al* showed that levels of measured cockroach allergens (Bla g 2) in the homes of low-income asthmatics living in New York City is associated with the degree of housing disrepair (leaking pipes, holes in ceilings or walls, un-repaired water damage, interrupted heat or electrical service, paint chips/peeling paint), and that the proportion of frequent cockroach sightings increased with the level of housing deterioration. These relationships persisted, even after adjusting for the effects of income, ethnicity, and pest control methods[36]. In a similar study carried out in Boston, Peters *et al* found that homes with clutter, lack of cleanliness, and holes in the wall or ceiling had elevated levels of cockroach allergen compared to other urban homes[37].

Lack of cleanliness / disrepair in the interior home environment, and associated asthma triggers in urban areas may be contributing to increased asthma rates seen in minority children living in inner-city areas across the United States. Studies have shown that poor children living in urban environments are more likely to be sensitized to cockroach allergens than children in suburban areas[6, 33, 38, 39], and the prevalence of sensitization to cockroach allergens has also been shown to increase as census tract area poverty increases[40]. There is evidence that early exposure to indoor allergens commonly

associated with deteriorated housing leads to sensitization and the susceptibility to develop asthma later on in life[41], and both sensitization and exposure to cockroach allergens is associated with increased asthma exacerbation among asthmatic children living in urban environs[42, 43].

1.II.C. PsychoSocial Factors

There is increasing evidence linking psychological stress to chronic illness in childhood[44, 45], and the link between stress and the expression of asthma and atopy has arisen as an active area of research. Psychosocial factors have been shown to contribute to both the onset of asthma in early childhood[46-48], the persistence of asthma into adulthood[48], and the exacerbation of existing asthma [14, 49, 50]. Parental stress has been associated with risk of wheezing among children in the first two years of life[48, 51], and the experience of life stressors was shown to be associated with same-day and lower peak flow as well as increased asthma attacks in the subsequent weeks[52]. In the National Cooperative Inner-City Asthma Study, inner-city children with asthma showed elevated levels of behavior problems (as measured by the CBCL), compared to a normative sample[53], and psychosocial factors, particularly the mental health of children and their caretakers, were significant factors in predicting asthma morbidity among inner-city children with asthma.[50]

The extent to which stress causes asthma or vice versa needs further study. Proposed models to explain the relationship between stress and asthma show a reciprocal relationship: stress can exacerbate asthma, which in turn creates more stress, which

exacerbates asthma further[53]. However, results from longitudinal, prospective studies have shown that asthma outcomes appear to follow earlier episodes of stress. Data from the Asthma Risk Study, a prospective study of psychological influences on 150 children genetically pre-disposed to developing asthma indicate that psychosocial predictors measured early in life are associated with both early asthma and the persistence of asthma in to age 8 in the study cohort[47, 48, 54]. Three variables from the first year of life independently predicted asthma onset by 8 years of age: increased atopic status (elevated serum IgE (≥10 IU/ml)), 8 or more respiratory infections during the first year of life, and parenting difficulties among the early weeks of an infants' life as measured by the Child Behavior Checklist.(CBCL). Interestingly, external stress was not an independent predictor of asthma, suggesting that the direct emotional caregiving could act to buffer external stressors on the child or his/her family.

Though the exact mechanism through which stress could affect the expression of asthma is not entirely clear, biological mechanisms have been proposed to explain how stress might "get under the skin" to physiologically alter the expression of asthma. Asthma is regulated through the immune system – when stress-related hormones and neuropeptides are released in excess during stress, dysregulation of immunological mechanisms can occur. For example, low SES as well as periods of stress associated with elevations in the TH2 response which can lead to the up-regulation of certain immune responses (cytokines) which in turn might enhance the response to allergen triggers and promote airway inflammation[14, 49, 55, 56]. Psychological stress can also disturb regulation of the hypothalamic-pituitary-adrenal axis, creating inappropriate levels of glucocorticoids and

catecholomines (cortisol dysregulation). This dysregulation in turn may cause inhibitory immune mediators to overreact, increasing an individual's susceptibility to inflammatory diseases such as asthma[13, 56, 57] A recently published study from Chen and colleagues has added genomic evidence to support these proposed theories : in a study of children with asthma from an economically diverse group of families, children with lower SES showed over-expression of genes regulating inflammatory processes compared to their wealthier counterparts, suggesting that the larger social environment may be able to affect processes at the genomic level[58].

While stress may play a direct role in the onset and exacerbation of asthma through physiologic dysregulation, stress may also have a more indirect impact on childhood by interfering with a caregiver or child's own ability to keep a child's asthma under control. Associations found between high levels of caregiver life stressors and children's asthma symptoms have been attributed to lack of adequate asthma management[59] as well as lower adherence to asthma medications or lack of access to preventive care[13]. Importantly, the levels of stress that child's caregiver faces can be mediated, or "buffered" by increased social support: with increased social support (either community level collective efficacy, family support, or coping mechanisms), caregivers of children with asthma have enhanced abilities to seek out and use health-relevant resources, eliminate environmental hazards that trigger asthma, and implement appropriate asthma management behaviors[19].

Despite a growing body of literature on psychosocial stressors and asthma, it is still difficult to determine whether psychological and behavioral problems are acting as independent predictors of asthma, or whether physiological stress is associated with other factors in the urban environment which are already acting to increase asthma outcomes among urban youth. Further longitudinal studies comparing the behavioral and psychological profiles of urban children with asthma to those without asthma is needed.

1.II.D. Contextual Effects

Despite the call to disentangle individual and community level predictors of asthma using a multi-level approach, to date, there have been few studies which have examined the role of the larger social environment along with individual characteristics. Further, the results of these studies have not been consistent, and further work is needed to replicate their findings. Claudio *et al* showed that children living in predominantly low socioeconomic status (SES) communities had a 70% greater risk of current asthma, independent of their own ethnicity and income level[60]. Gupta and colleagues studied asthma patterns in 41,255 children living in 287 Chicago urban neighborhoods. They found that childhood asthma prevalence varies widely by neighborhood, and that as the percent of the population that is black and the poverty level increased in a community, so did the prevalence of asthma. Despite this finding, multi-level models showed that ethnicity did not explain all of the geographical variation by neighborhood, suggesting that race may be serving as a proxy for unmeasured social or environmental risk factors[20]. Cagney and Browning identified individual- and neighborhood-level factors that are associated with the prevalence of asthma and respiratory disease in 338 Chicago neighborhoods. At the individual level,

female gender, smoking, and weight problems were positively associated with asthma/breathing problems, while Latino ethnicity was protective. Community level collective efficacy was protective against respiratory outcomes, and individual level residential stability was only associated with respiratory outcomes after levels of collective efficacy were controlled for[19]. Saha *et al*, examined individual and neighborhood level predictors of asthma in a sample of 2544 children, ages 5 to 18 years old who received care in a network of urban primary care clinics in Indiana. Contrary to other multi-level studies, their results did not show contextual level affects on asthma rates. Poor neighborhoods had higher rates of asthma than middle or moderate income neighborhoods, however, none of the census-block characteristics (median age of housing, MFI, % of single-parent families, % of people aged 25 years or older) were significant predictors of asthma. Individual level variables: race sex, age, and BMI *were* associated with an ever diagnosis of asthma[61].

Results from these studies have provided preliminary insights into sources of variation in asthma rates among urban youth, however, clarification and replication of their findings is needed. For example, Gupta and colleagues were only able to consider a limited number of social and environmental predictors in their analysis. Cagney and Browning's analysis in Chicago neighborhoods was not restricted to children, and Saha's analysis was limited to older children. Further, all of these authors' analyses were limited to cross-sectional data which relied on self-report of outcome and most exposures, increasing the possibility of bias away from the null. Cagney and Browning remarked that while they found that income, education, insurance and regular source of care were

not associated with respiratory problems, they did not examine whether these factors were associated with more severe markers of asthma such as hospitalization[19].

A 2006 multi-level analysis using data from the Fragile Children and Families cohort at age 3 examined whether or not the association between low birth-weight and asthma can be explained by an extensive set of individual and neighborhood level measures[62]. They found that low-birthweight was associated with diagnosis of asthma at age 3, and, interestingly, that neighborhood level variables such as living in census tracts with higher vacancy and renter-occupied housing rates were identified as independent predictors of asthma. This 2006 study was the first to document independent associations of early childhood asthma with neighborhood level vacancy rates. However, it focused primarily on the relationship between low birth weight and asthma, relied on parent report of "ever-diagnosis" of asthma during the very early years of life (an unstable diagnosis), and did not consider important individual-level data on stress, economic disadvantage, and the physical conditions of the home environment.

In winter 2008 more complete FCF cohort data will become publicly available for the 3rd, 4th, and 5th years of life, allowing for further analyses which incorporate information on housing quality, stress, socio-economic disadvantage, and other social determinants of health. More importantly, data available from the age 5 visit allow for a more accurate identification of childhood asthma.

Chapter 2: Study Significance, Rationale, and Study Objectives

2.I. Significance of the proposed dissertation

Asthma disparities have been repeatedly shown to exist in the United States, with urban, minority children experiencing asthma at much higher rates than their suburban counterparts. Importantly, some urban neighborhoods have higher rates of asthma than others, and some individuals living within urban neighborhoods are more likely to suffer from episodes of severe asthma than others. A closer analysis of *which* characteristics in the urban environment are important risk factors for asthma is warranted, with careful examination of the relative importance of individual and neighborhood characteristics. To date, it remains unclear (1) what specific characteristics put some urban children at greater risk for asthma than others, (2) the extent to which asthma varies by urban neighborhoods (3) what neighborhood characteristics are associated with the induction or exacerbation of asthma in children, and (4) whether individual level characteristics have a greater impact on asthma risk than the effects of the neighborhoods that children live in. Findings from our study will lead to a greater understanding of the multi-factorial influences on asthma. Also, through identification of individuals and geographic areas which are likely to have a higher prevalence of asthma, this study will inform targeted interventions to reduce asthma and its associated morbidity in urban areas.

2.II. Goals and Specific Aims

The overall goal of the proposed dissertation is to explore factors in the physical, social, and psychosocial environment which are associated with asthma in U.S. urban children. Three separate analyses will be carried out. In *manuscript 1*, I will examine

socioeconomic predictors of asthma at the individual and neighborhood level using multi-level analysis. In *manuscript 2*, I will examine the relationship between psychosocial stressors and ER utilization for asthma. In *manuscript 3*, I will examine the relationship between Child's BMI, staying indoors due to neighborhood violence, and report of having an asthma attack.

2.II.A. Specific Aims

Manuscript 1: Economic disadvantage and asthma diagnosis: The impact of individual and neighborhood-level factors

Specific Aim 1 (Manuscript 1): *Describe the characteristics of the sample by measures of asthma*

- Hypothesis 1a: Asthma diagnosis is associated with individual and neighborhood markers of economic disadvantage.
- Hypothesis 1b: Asthma diagnosis is associated with markers of deteriorating housing conditions

Specific Aim 2 (Manuscript 1): *Examine variation and clustering in asthma among U.S. urban census tracts*

- Hypothesis 2a: Rates of asthma episodes vary among U.S. urban census tracts
- Hypothesis 2b: Rates of asthma episodes cluster by U.S. urban census tracts

Specific Aim 3 (Manuscript 1): *Examine the impact of neighborhood level disadvantage, after controlling for individual level disadvantage.*

- Hypothesis 3a: Individual level *economic disadvantage* explain a significant amount of the variation in asthma
- Hypothesis 3b: Individual level *housing quality* will explain a significant amount of the variation in asthma exacerbations
- Hypothesis 3c: Neighborhood level *economic disadvantage* will explain some of the variance in asthma, even after controlling for individual level variables.

- Hypothesis 3d: The relationship between individual level *economic disadvantage* and asthma will be steeper in neighborhoods with greater levels of *economic disadvantage*

Manuscript 2: Psychosocial Stressors and ER utilization for asthma

Specific Aim 1 (Manuscript 2): *Examine the relationship between Psychosocial Factors and ER utilization for asthma*

- Hypothesis 1a: Children who have higher scores on the *Child Behavior Checklist (CBCL)* will be more likely to have utilized the health care system for asthma in the last year

- Hypothesis 1b: Children of mothers who face increased psychosocial stressors (high stress, low self-efficacy, depression, or low social support) will be more likely to have utilized the health care system for asthma in the last year,

Specific Aim 2 (Manuscript 2): *Examine the relationship between the neighborhood social environment and ER utilization for asthma*

- Hypothesis 2a: Children who live in neighborhoods with low levels of social control and social cohesion (collective efficacy)will be more likely to have utilized the health care system for asthma in the last year,

Manuscript 3: Child's BMI and Asthma Attacks in Young Urban Children

Specific Aim 1 (Manuscript 3): *Examine the relationship between a child's BMI and report of an asthma attack in the last year.*

- Hypothesis 1a: Children who are overweight or obese will be more likely to report having an asthma attack in the last year compared to children who are normal/underweight.

Specific Aim 2 (Manuscript 3): *Examine the relationship between a mother's fear of letting her child play outdoors due to neighborhood violence, and whether or not her child has an asthma attack in the last year.*

- Hypothesis 2: Children of mothers who are afraid to let their child play outdoors due to neighborhood violence will be more likely to have an asthma attack

Specific Aim 3 (Manuscript 3): *Determine whether a child's BMI mediates the relationship between staying indoors due to neighborhood violence and having an asthma attack.*

- Hypothesis 3: Children of mothers who are afraid to let their child play outdoors due to neighborhood violence will be more likely to have an asthma attack due to higher BMI.

Chapter 3: Overview of Methods

Specific details on the methods and measures used in each manuscript are given in Chapters 4, 5, and 6. This chapter provides an overall description of the study sample and data collection methods, as well as proposed analytic plans for each of the three manuscripts.

3.I. Description of the Sample

The Fragile Families and Child Wellbeing Study (FCF) is a longitudinal, prospective cohort of nearly 5,000 U.S. children born in over 20 large cities. The study follows a 1998-1999 birth cohort from 20 large cities in 15 different states across the US. The primary purpose of the study is to examine how parental resources influence young children living in urban environments, and to provide insight into the ways in which public policies which impact parental resources can affect child well-being. Cities chosen for inclusion in the sample were: Indianapolis, IN, Austin, TX, Boston, MA, Santa Ana, CA, Richmond, VA, Corpus Christi, TX, Toledo, OH, New York, NY, Birmingham, AL, Pittsburgh, PA, Nashville, TN, Norfolk, VA, Jacksonville, FL, San Antonio, TX, Philadelphia, PA, Chicago, IL, Newark, NJ, Oakland, CA, Detroit, MI, and San Jose, CA. Births were randomly sampled from hospitals within the city limits of these hospitals, until pre-determined quotas were filled: non-married births were over-sampled at a ratio of 3 to 1 in order to ensure that questions regarding the health and well-being of urban children born to unmarried parents could be answered.

More detailed data was also collected on a sub-sample of the FCF children for the In-Home Longitudinal Study of Pre-Schooled Age Children (LSPAC). The In-Home LSPAC is a collaborative FCG study which contains information on a variety of domains of a child's environment including the physical environment (quality of housing, nutrition and food security, health care, adequacy of clothing, and supervision), as well as parenting (discipline, parental attachment, and cognitive stimulation). The LSPAC study also collects data on anthropometric measurements, child behavior, and cognitive ability. The survey consists of two components. In the first component an in-home parent interview is conducted which collects information from the parents on the health, well-being, and behavior of the child and records interviewer observations of the home environment. In the second component, an activity assessment which includes tests for children's cognitive functioning and anthropometry[63].

3.II. Sampling Methodology

The FCF sampling strategy was Multi-Stage, stratified random sampling: cities were sampled first, followed by hospitals, then births.

Sampling at the City Level

The sampling frame at the city level consisted of a roster of 77 cities (all U.S. cities with a population of 200,000 or more in 1993). All 77 U.S. cities were first scored on the conditions of their policy environment (ie welfare generosity, strength of child support system, and strength of the local labor market.) Cities were then scored as either having extreme (ie generous/ strict) or moderate environment on each of those variables. From these scores, cities were stratified into 1 of 3 groups. Eight cities were chosen from group

1, eight cities from group 2, and 4 cities were chosen from group 3, for a total of 20 cities. This sampling strategy ensured heterogeneity of policy environments for researchers examining the role of welfare, labor, and child support policies in child health and well-being.

- City Group 1 included cities with only *extreme* environments on policy variables. Within this extreme group, cities were further stratified into 8 categories of different combinations of extreme policy environments (ex: generous welfare, strict child support, strong labor market). From each of these 8 combinations of extreme environments, one city was chosen, for a total of 8 cities. This technique ensured representation of extreme policy environments which were both strict and generous. In each of the 8 chosen cities with extreme policy environments, 325 births were sampled (250 non-marital, 75 marital). Births were sampled probabilistically with a selection probability that was proportional to population.

- City Group 2 included cities with only *moderate* environments on policy variables. From this moderate group, 8 more cities were selected randomly. In each of these 8 cities with moderate policy environments, 100 births were sampled (75 non-marital, 25 marital) were sampled. Births were sampled probabilistically with a selection probability that was proportional to population.

- City Group 3 included cities chosen because study investigators had a *particular research interest* in a city. 4 cities were chosen from this group.

Sampling at Hospital level

The sampling frame at the hospital level included all birthing hospitals within city limits. If there were 5 or less birthing hospitals within city limits, interviews were conducted at all 5 hospitals. In larger cities (New York and Chicago) with >5 birthing hospitals, a random sample of birthing hospitals with >100 non-martial births each year was chosen. The following cities and hospitals were included in the sample:

1) **Austin:** Brackenridge Hospital, Columbia St. David's Medical Center, Seton Medical Center
2) **Oakland**: Alameda Co. Medical Center, Summit Medical Center
3) **Baltimore:** Johns Hopkins Hospital, Mercy Medical Center, Sinai Hospital of Baltimore, Union Memorial Hospital, University of Maryland Medical System
4) **Detroit**: Henry Ford Hospital, St. John's Detroit Riverview Hospital, Wayne State: Hutzel, Wayne State: Sinai/Grace
5) **Newark:** Newark Beth Israel Medical Center, Columbus Hospital, St. James Hospital, St. Michael's Medical Center, Univ. of Medicine and Dentistry of NJ (UMDNJ)
6) **Philadelphia**: Albert Einstein Medical Center, Episcopal Hospital, Hospital of University of Pennsylvania (HUP), Pennsylvania Hospital, Temple University Health Services Center, Thomas Jefferson University Hospital
7) **Richmond**: Chippenham Medical Center, Medical College of Virginia
8) **Corpus Christi:** Columbia Doctor's Regional Hospital, Christus Spohn Hospital South, Christus Spohn Memorial Hospital, Columbia Bay Area Medical Center
9) **Indianapolis:** Methodist Hospital of Indiana, Wishard Health Services, St.Vincent Hospitals and Health Services
10) **Milwaukee:** Sinai-Samaritan Medical Center, St. Joseph's Hospital, St. Mary's Hospital
11) **New York City:** Elmhurst Hospital Center, Mt. Sinai Medical Center, Long Island College Hospital, New York Presbyterian Medical Center, North Central

Bronx Hospital, NY Hospital - Cornell Medical Center, Harlem Hospital Center, Lutheran Medical Center

12) **San Jose**: Santa Clara Valley Medical Center, Regional Med. Ctr. of San Jose, Santa Teresa Community Hospital, Kaiser Permanente Santa Clara
13) **Nashville:** Baptist Hospital, Centennial Medical Center, Vanderbilt Univ. Medical Center
14) **Boston**: Brigham and Women's Hospital[1], Beth Israel Deaconess Medical Center, Boston Medical Center
15) **Chicago**: University of Chicago Hospital, Michael Reese Hospital and Medical Center, Cook County Hospital, Mt. Sinai Hospital, Mercy Hospital and Medical Center, Northwestern Memorial Hospital
16) **Jacksonville:** University Medical Center, St. Vincent's Medical Center, Baptist Medical Center
17) **Norfolk**: Sentara Norfolk General Hospital, Sentara Leigh Hospital
18) **Toledo:** Toledo Hospital, St. Vincent Mercy Medical Center
19) **San Antonio:** Southwest Methodist Hospital, Christus Santa Rosa Hospital, Metropolitan Methodist Hospital, Baptist Medical Center, University of Texas Health Science Center
20) **Pittsburgh:** Magee-Women's Hospital, Allegheny General Hospital, Mercy Hospital of Pittsburgh

Sampling of Births

The sampling frame at the birth level included a list of all births occurring within city hospitals listed above. Quotas were set for marital and non-marital births (at 1:3)[2] ratio, and births were randomly selected from birth lists at hospitals until the quotas were filled. sample. Births were not sampled if any of the following criteria were met: 1) the parents planned to put the baby up for adoption, 2) the father was not living at the time of the

[1] Data collection agreements were created with hospital staff, however, at commencement of data collection, FCF staff were prohibited from commencing data collection.
[2] Unmarried mothers were over-sampled in order to obtain detailed information on outcomes for children of unwed parents.

birth, 3) the parents did not speak English or Spanish well enough to complete a baseline interview in the hospital 4) the parents were too ill to complete the interview, 5) the baby died before the interview could take place.

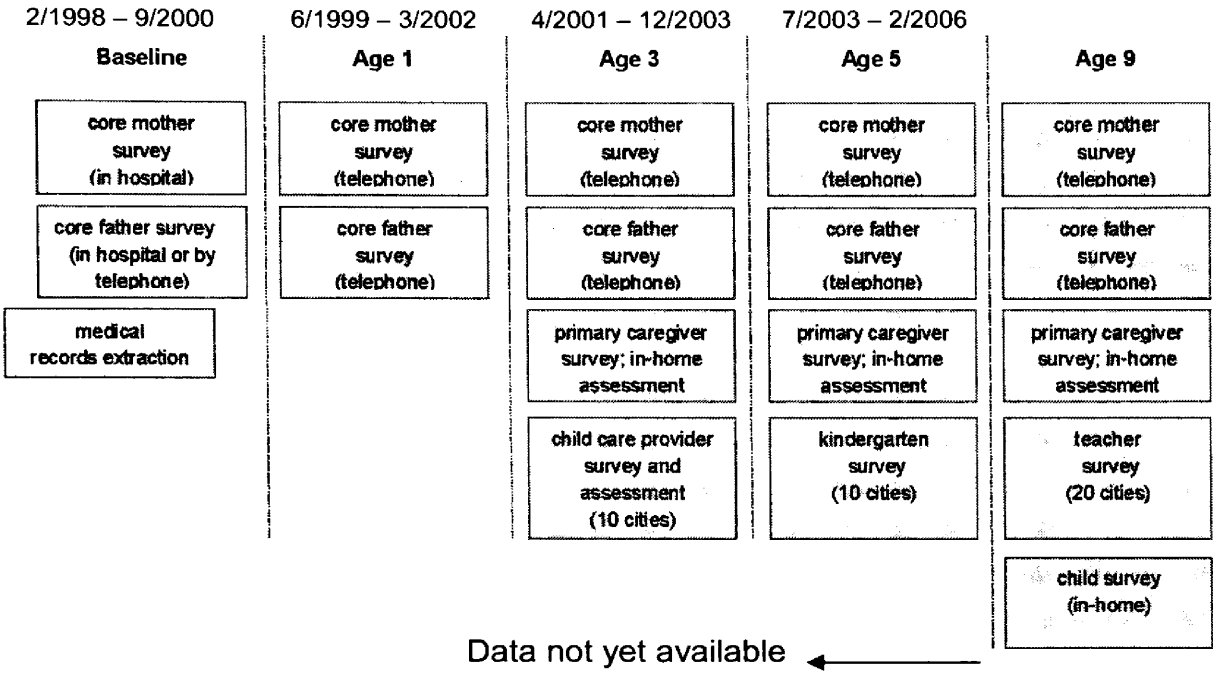
V. Participation in the FCF In-Home Sample (data used for this study)

More detailed data was also collected on a sub-sample of the FCF CORE sample for the In-Home Longitudinal Study of Pre-Schooled Age Children (LSPAC). The In-Home LSPAC is a collaborative FCF study which contains information on a variety of domains of a child's environment including the physical environment (quality of housing, nutrition and food security, health care, adequacy of clothing, and supervision), as well as parenting (discipline, parental attachment, and cognitive stimulation). The LSPAC study also collects data on anthropometric measures during the home visit.

3.III. Data Collection

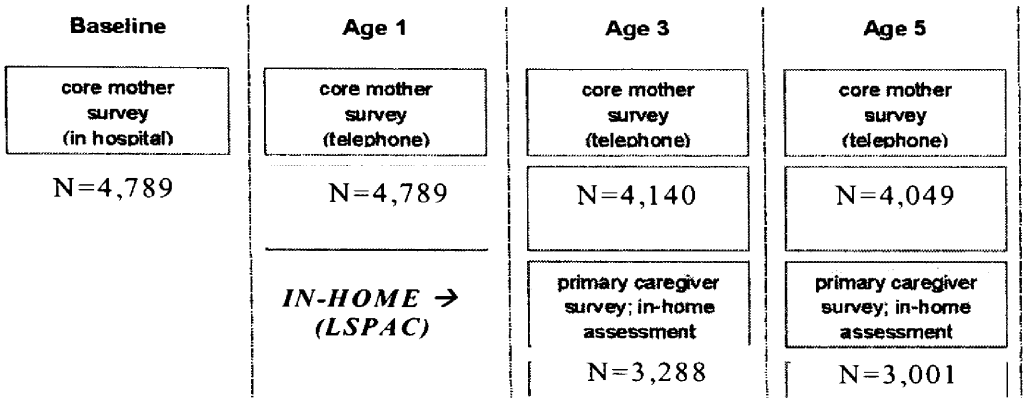
The FCF study is a longitudinal, prospective study which follows children born in hospital in U.S. urban areas from birth through early childhood. Figure 2 shows the data collection schedule for the first 9 years of the children's life. A total of 4,898 mothers were interviewed at Baseline. Baseline interviews were conducted by trained interviewers in the hospital after the birth, and 3 and 5 year follow-up interviews took place either by telephone or in the home of the primary caregiver. Medical records data and contextual level data (i.e., city identifiers and census tract variables) are also available though restricted use contract.

Figure 2: Data Collection Schedule for the Fragile Children and Families Study



Approximately seventy nine percent (79%) of the respondents of the Three-Year Core survey participated in the Three-Year In-Home Longitudinal Study of Pre-School Aged Children module (in short, the Three-Year In-Home module). Of these, about seventy-eight percent (78%) of the participants completed both components of the In-Home survey. Most of the remaining participants completed only the parent interview over the telephone because the parent or the care giver refused a home visit or such visit could not be conducted because the family had moved away from the city where the child was born. Figure 3 below shows the number of children who participated in the FCF CORE survey panels, as well as the In-home (LSPAC) sub-sample panels, through year 5 of the study.

Figure 3: Sample sizes for children participating in the FCF CORE study and the FCF In-Home Sub-sample



In addition, the FCF provides census tract data and medical records data through a restricted use contract. Census tract data is available for families in which the residence could be determined: 4,725 mothers (96% of total) at baseline. The actual tracts of residence are not included on these files to protect the privacy of respondents. Instead, a file is available which contains the characteristics of the census tract that each individual lives in. The identity of the city in which a child was born is available through restricted use contracts. In early 2009, data was made available for the 5 year visit.

3.IV. Proposed Analytic Plan

3.IV.A. Proposed Analytic Plan for Manuscript 1

In Manuscript 1 hierarchical (multi-level) modeling will be used to simultaneously examine the effects of individual and neighborhood disadvantage on episodes of asthma. The nested structure of the FCF data is appropriate for multilevel modeling techniques: this dataset contains individual level characteristics of the home environment, as well as census tract level information. Hierarchical (multi-level) models (HLM) explicitly

recognize that children within a particular neighborhood may be more similar to one another than those in another neighborhood, creating correlated or clustered observations. Failure to account for non-independence of observations can result in standard errors that are biased downward, increasing the chances of reaching incorrect conclusions[64]. Hierchical models account for any clustering that may exist (by census tract) and correct for correlated errors, allowing unbiased estimates of coefficients and their standard errors and correct confidence intervals and statistical tests. Further, HLM provides a *convenient framework* for studying relationships which are hierarchical in nature.

In Nepomnyaschy and Reichman's 2006 multi-level study using FCF data, the authors reported that they did not see large amounts of clustering by census tract, and on average only had around 1.5 people per cluster using data from the FCF 3 year visit[62]. Thus, if clustering by census tract does not appear to be warranted in the proposed 5 year analysis, alternative analytic techniques will be considered (binary logistic regression). Because the sampling scheme of FCF produced cities which were diverse both in their policy environments (welfare, child support, and labor market conditions) city variables will also be considered as a potential clustering variable.

Specific Aim 1 (Manuscript 1): *Describe the characteristics of the sample by asthma episodes*

- Methodology for Specific Aim 1 (Manuscript 1):
  Bivariate analysis: Two-tailed t-tests for comparison of continuous variables and Chi-square tests for categorical variables

Specific Aim 2 (Manuscript 1): *Examine variation in asthma among U.S. urban a census tracts*

- Methodology for Specific Aim 2 (Manuscript 2): *Random effects modeling for binary outcomes using the intercept only model (SAS proc GLIMMIXED).*

  - Assuming that Y_{ij} is a binary response for individual i in cluster j, and the probability of the response being equal to 1 is $p_{ij} = Pr(yij = 1)$ with p_{ij} modeled using the logit link function

- $Log(p_{ij} / (1-p_{ij})) = \gamma 00 + \mu_{ij} + r_{ij}$

  - $\gamma 00$ is the grand mean (fixed effect)
  - μ_{ij} is the cluster mean (random effect) r_{ij} is the individual variance (deviation of the ith individual from the jth cluster mean.)

Specific Aim 3 (Manuscript 1): *Examine the impact of neighborhood level disadvantage, after controlling for individual level disadvantage.*

- Methodology for Specific Aim 3 (Manuscript 2): *Random effects modeling for binary outcomes. (SAS proc NLMIXED).*

- <u>*Model 1:*</u> *Individual level SES*

  $Log(p_{ij} / (1-p_{ij})) = \gamma 00 + \gamma 10X_{ij} + \mu_{ij} + r_{ij}$

  Where:
  - $\gamma 00$ is the grand mean (fixed effect)
  - μ_{ij} is the cluster mean (random effect) r_{ij} is the individual variance (deviation of the ith individual from the jth cluster mean.)
  - $\gamma 10X_{ij}$ is the individual level variable (fixed effect)

- <u>*Model 2:*</u> *individual level SES, neighborhood level SES*
  $Log(p_{ij} / (1-p_{ij})) = \gamma 00 + \gamma 01W_{ij} + \gamma 10X_{ij} + \mu 0_j + r_{ij}$

  Where:
  - $\gamma 00$ is the grand mean (fixed effect)
  - μ_{ij} is the cluster mean (random effect) r_{ij} is the individual variance (deviation of the ith individual from the jth cluster mean.)
  - $\gamma 01W_{ij}$ is the cluster level variable (fixed effect)
  - $\gamma 10X_{ij}$ is the individual level variable (fixed effect)

- <u>*Model 3:*</u> *individual level SES, neighborhood level SES, interaction term*
  $Log(p_{ij} / (1-p_{ij})) = \gamma 00 + \gamma 10X_{ij} + \mu_{1j}X_{ij} + r_{ij}$

Where:

- p_{ij} is the probability of an asthma episode for the ith individual in the jth cluster
- $\gamma 00$ is the grand mean (fixed effect)
- μ_{ij} is the cluster mean (random effect) r_{ij} is the individual variance (deviation of the ith individual from the jth cluster mean.)
- $\gamma 10 X_{ij}$ is the individual level variable (fixed effect)
- $\mu 1_j X_{ij}$ is the interaction term for the cluster dummy variables and the individual predictors (allowing the level 1 slopes to vary)

3.IV.B. Proposed Analytic Plan for Manuscript 2

Bivariate analysis will be used to determine which explanatory variables are associated with the outcome. These variables will be entered into the logistic regression model using forwards, backwards, and stepwise selection techniques, and the fit of the model will be assessed after each variable is added or deleted.

Specific Aim 1 (Manuscript 2): *Examine the relationship between Psychosocial Factors and ER utilization for asthma*

- *Bivariate analysis: Two-tailed t-tests for comparison of continuous variables and Chi-square tests for categorical variables*
- *Logistic Regression Models using Maximum Likelihood Estimation (SAS: Proc Logistic)*

$$\text{logit}(p_i) = \ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 x_{1,i} + \cdots + \beta_k x_{k,i}.$$

Where p is the probability of having a visit to the ER or urgent care because of asthma, and $x_{1,i}$.....$x_{k,i}$ represent the explanatory variables: stress (Child Behavior problems, HOME Scale, Major Depressive Episodes, Generalized Anxiety Disorder), and other potential confounders/effect modifiers

3.IV.C. Proposed Analytic Plan for Manuscript 3

Bivariate analysis will be used to determine which explanatory variables are associated with the outcome. These variables will be entered into the logistic regression model using

forwards, backwards, and stepwise selection techniques, and the fit of the model after each variable is added or deleted.

Specific Aim 1 (Manuscript 3): *Examine the relationship between a child's BMI and report of an asthma attack in the last year.*

Specific Aim 2 (Manuscript 3): *Examine the relationship between a mother's fear of letting her child play outdoors due to neighborhood violence, and whether or not her child has an asthma attack in the last year.*

Specific Aim 3 (Manuscript 3): *Determine whether a child's BMI mediates the relationship between staying indoors due to neighborhood violence and having an asthma attack.*

- *Bivariate analysis: Two-tailed t-tests for comparison of continuous variables and Chi-square tests for categorical variables*

- *Logistic Regression Models* using Maximum Likelihood Estimation (SAS: Proc Logistic)*

$$\text{logit}(p_i) = \ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 x_{1,i} + \cdots + \beta_k x_{k,i}.$$

Where pi is the probability of having a diagnosis of asthma, and $x_{1,i}...x_{k,i}$ represent the explanatory variables: stress

Chapter 4: Economic disadvantage and asthma diagnosis: The impact of individual and neighborhood factors.

The purpose of this study was to examine the cross-sectional relationship between individual and neighborhood markers of economic disadvantage (socio-demographic characteristics, housing quality, and neighborhood characteristics), and diagnosis of asthma in young urban children.

4.I. METHODS

4.I.A. Study Sample

The Fragile Families and Child Wellbeing Study (FCF) is a longitudinal, prospective cohort of 4,898 U.S. children born in over 20 large cities since 1998 (unmarried mothers were over-sampled). Baseline data was collected at the time of the child's birth, and follow-up telephone interviews were conducted in 3 and 5 year follow-up waves. A flowchart outlining the study sample used for this analysis is shown in Figure 1. Data on demographics, medical care, and health came from FCF Wave 5 mothers' telephone interviews. Data on housing quality and conditions of the immediate block came from the 5 year visit of the In-Home Longitudinal Study of Pre-School Aged Children, an FCF sub-study conducted among 3001 FCF families. Census tract data measuring neighborhood composition in the tracts in which FCF participants lived at the time of the baseline interview (1998-2000) came from 2000 U.S. census data.

In order to be included in the analysis, participants must have non-missing data for each of the measures used in the assessment of the interior home, the exterior home, and the block, as well as non-missing data on each of the census tract variables used in the

analysis. Any variables on the measures assessing conditions of the home and block marked as "not observed" were designated as missing. Of the 3001 children participating in the In-Home study, 2,031 had complete census tract data. Of these, 1,927 had complete data on the condition of the block. 1,954 had complete data on the presence of cracks or holes in the walls or ceiling and evidence of rodents. 1,979 had complete data on the assessment of clutter, crowding, and cleanliness in the interior home. 1,977 had complete data on the assessment of the exterior home. 1,784 participants had complete measurements on *all* measures of the interior and exterior home and other covariates included in the models.

4.I.B. Outcome Measure

As shown in Figure 1, the outcome variable for this analysis was defined as whether or not a child had ever received an asthma diagnosis by the five year visit. At the 5 year telephone survey, mothers were asked, *"Has a doctor or other health professional ever told you that your child has asthma?"* In the sub-sample used for this analysis, 409 (22.2%) mothers reported that their child had received an asthma diagnosis, while 1,451 (78.0%) mothers reported that their child had never received a diagnosis of asthma. In sensitivity analyses we also examined whether results changed when asthma attack was used as an outcome rather than asthma diagnosis. Asthma attack was assessed, using the question: *"During the past 12 months has your child had an episode of asthma or an asthma attack?"*

4.I.C. Explanatory Variables

The primary explanatory (independent) variables of interest included a) individual-level socio-demographic characteristics, and housing quality (interior and exterior conditions of the child's home at the 5 year in-home visit), and b) measures of the social and physical environment (conditions of the immediate block and census-tract level variables). These measures are described in detail below.

Individual Level Data

4.I.C.i. Socio-Demographic Characteristics, Medical Care, and Health

Socio-demographic measures included household income as % of federal poverty threshold (calculated), mother's self-reported race/ethnicity, mother's education level, and child's gender. Because children who have allergies are at a higher risk for developing asthma than non-allergic children, a measure of allergic status *(whether a child has had symptoms of hayfever or allergy in the last 12 months)* was measured and included as a covariate in all models. Access to medical care was measured by asking mothers whether or not the child had a usual place for routine health care, such as regular check-ups, and where this place was (doctor's office, hospital/outpatient clinic, or other clinic). A child's health insurance status was assessed at the 5 year visit by asking mothers whether they were covered by Medicaid (Yes/No), and if no, whether or not the child was covered by private health insurance (Yes/No). If a mother answered no to both of these questions, the child was assumed to lack health insurance coverage. Smoking status was assessed by asking mothers whether or not there was one or people who smoked inside the household.

4.I.C.ii. Conditions of Children's Housing and the Immediate Block

Conditions of each child's exterior and interior home environments as well as his/her immediate block, were individually assessed by trained interviewers during the 5 year visit of the In-Home Longitudinal Study of Pre-School Aged Children (ie data was collected separately on each study participant. For the assessment of conditions of the immediate block, trained interviewers recorded the conditions of the block surrounding *each* child's home. Because the exact address of study participants was not available for privacy reasons, individual level data assessing conditions of the immediate block could not be aggregated into neighborhood/block level data[3].) Home exteriors were designated as being in "Poor Condition" if there was interviewer-observed evidence of peeling paint, crumbling walls, or broken windows. Home interiors were designated as being in "Poor Condition" if there was interviewer-observed evidence of cracks or holes in the walls/ceiling, and/or dark, crowded, cluttered or noisy interiors, or evidence of rodents. This variable was further separated into two variables: one which measured physical deterioration of a child's interior home environment, and another measuring social disorder in a child's interior home environment. A child's immediate block was designated as being in "Poor Condition" if interviewers noted evidence of graffiti, litter, or neighboring homes that were vacant or in poor condition. All assessment scales were based on validated questions from the The Home Observation for Measurement of the Environment (HOME) interior and exterior subscales from the Project on Human Development in Chicago Neighborhoods (PHDCN)[65].

[3] Based on the low clustering rate of census tract data, it is unlikely there was clustering by block (ie that several participants lived on the same block. Thus, if models had been able to treat block as a *neighborhood level* characteristic, model results would likely have been similar.

Neighborhood Level Data

4.I.C.iii. Neighborhood Characteristics: Census Tract Data

Socio-demographic characteristics of a child's larger neighborhood environment were measured via U.S. 2000 census tract variables corresponding to the geographic coordinates of the residence in which a mother lived at the time of the baseline interview[4]. Census tract measures considered for inclusion in the analysis included: % of population with at least a HS education, % of civilian labor force unemployed, % of households on public assistance, % of housing units vacant, % of housing units renter-occupied, % of population non-Hispanic Black, % of population with a Bachelor's Degree or Higher, and % of families below the poverty level in 1999. Each participant living within a defined neighborhood/census tract boundary was assigned the same value for the variables listed above.

4.I.D. Analysis

4.I.D.i. Census Tract Variables

Table 1 shows correlations between Census Tract Variables considered for use in the analysis. Pearson's r values for correlations between census tract variables ranged from 0.32 to 0.85. Three variables (% of population with at least a HS education, % of civilian labor force unemployed, and % of households on public assistance) originally considered for inclusion were collinear (Pearson's $r > 0.70$) with at least one other variable, and thus were not included in multivariate analyses. As expected, census tract variables measuring economic disadvantage were associated with individual level markers of economic disadvantage (data not shown). For example, on average, children who lived on blocks with surveyor measured indices of deteriorating neighborhood conditions (graffiti,

[4] Census tracts are small, relatively stable geographic areas that usually have a population of 2,500 to 8,000.

litter, vacant or deteriorating homes), had a higher percentage of vacant housing units in their neighborhood as measured by 2000 census data. In primary analyses, all census tract variables were kept as separate measures in order to distinguish effects. In sensitivity analyses we also combined census tract variables into a scale by summing all variables (with % of adults having obtained a bachelor's degree reverse coded).

4.I.D.ii. Clustering of Observations by Census Tract

Children included in the sample came from 1,414 different census tracts. 72.7% of census tracts had only one participant per tract, 18.3% had 2 individuals per tract, and 5% had 3 individuals per tract, 2% had 4 individuals per tract, and <1% had 5,6,7,or 9 individuals per tract. Results from unconditional means (random effects) modeling showed that there was almost no clustering by census tract: *ie* almost none of the variance in asthma diagnosis is attributable to variations among the census tracts (ICC = 6.55*E-16)[5]. Preliminary results of multi-level models that accounted for clustering of individuals by census tract were compared to results using Logistic Regression models that did not account for clustering. Because there was almost no clustering of individuals by census tract, results of modeling techniques were identical, and Logistic Regression analysis using maximum likelihood estimation was chosen as the primary analytic technique.

[5]Nepomnyaschy and Reichman's 2006 analysis using census tract and FCF core data from the 3 year panel showed similar results. The authors noted, "there was in fact little clustering of observations within neighborhoods in our data. There were on average 1.5 births per census tract, and 69% of the 1174 tracts contained only 1 birth (ICC value not provided". The authors went on to note that "logistic regression models that did not account for clustering of births in certain neighborhoods produced results virtually identical to the multilevel results presented." [62]

4.I.D.iii. Statistical Analysis

The prevalence of asthma diagnosis was compared across demographic, housing, and neighborhood characteristics, and Unadjusted Odds Ratio's and 95% Confidence Intervals were calculated. Then, 6 separate multivariate logistic regression models were constructed to examine the relationship between individual, housing, and neighborhood characteristics and asthma diagnosis, and to examine the extent to which variables were acting as mediators. Model 1 included individual level characteristics only, Model 2 included housing characteristics only, and Model 3 included census tract variables only. Model 4 included individual and housing characteristics in the same model, but no census tract characteristics, Model 5 included individual and census tract but no housing characteristics, and Model 6 included individual, housing, and census tract characteristics. Goodness of fit for the 6 models was compared using AIC and R-squared values. All analyses were performed using SAS version 9.1.

4.II. RESULTS

4.II.A. Description of the Study Sample

According to mothers' report, 21.1% of children in our sample had received a diagnosis of asthma by the age of 5. The prevalence of diagnosis in our sample is higher than the 2005 national average for children (8.9%)[1] however, this finding is not surprising given that our sample consists of children from U.S. urban areas, where rates have been consistently shown to be higher than in suburban and rural areas. Of the 1,784 mothers of children included in our sample, 44.1% reported incomes that were below the federal poverty threshold, 19.2% reported their race as white, 53.5% as black, 13.9% as

Mexican, and 3.2% as Puerto Rican. 68.2% of mothers were not married at the time of the 5 year interview, 39.2% of mothers had not completed high school, and 41.3% reported that one or more people smoked cigarettes inside of their home. 52.0% of children were male and 2.4% had experienced symptoms of hayfever or respiratory allergies in the last 12 months. 59.8% of children named Medicaid as their source of health insurance, 34.3% had private health insurance, and 5.9% had neither public nor private insurance coverage. Detailed data on socio-demographic, housing, and neighborhood characteristics of study participants are shown in Tables 2 and 3.

4.II.A.i. Bivariate Analysis

Table 4a shows the prevalence of Asthma Diagnosis by five years of age by socio-demographic, housing, and neighborhood characteristics. The prevalence of asthma diagnosis was significantly higher among black and Puerto Rican children, compared to white children. Asthma prevalence was also higher among children whose mothers had lower income and education levels, among male children, among those with hayfever, and among children who were exposed to environmental tobacco smoke (ETS) inside the home. Prevalence was also higher among children who lived in homes with poor interior and exterior conditions, in blocks which were in poor condition, and among children who lived in neighborhoods with higher prevalence of economic disadvantage as measured by census tract variables.

4.II.A.ii. Reults : Socio-Demographic Characteristics

The prevalence of asthma diagnosis was 12.6% among white children, 23.7% among black children, and 40.4% among Puerto Rican children. In unadjusted analyses, compared to white children, black children were 2.2 (95% CI 1.5, 3.1) and Puerto Rican children were 4.7 (95% CI 2.5, 8.7) times more likely to have received a diagnosis of asthma by age 5. Adjustment for individual level indicators of income, education, health insurance, and housing attenuated but did not completely explain the relationship between race and asthma diagnosis (Table 4a, model 1). Further adjustment for housing and neighborhood level characteristics (Table 4b, models 4 and 5) did not substantially change estimates for race beyond those in model 1.

The prevalence of asthma diagnosis was 15.9% among children whose household income was 300% or more of the federal poverty level, 21.4% among children whose household income was 100-299% of the federal poverty level, and 23.0% among children whose household income was below (<100%) the federal poverty level. In unadjusted analyses, children whose household level was at (100-199%) or below (<100%) the federal poverty level were 1.4 (95% CI 1.0, 2.0) and 1.6(95% CI 1.1, 2.2), times more likely to have received a diagnosis of asthma than children who were 300% or more of the federal poverty level. However, after adjustment for race, insurance, and other individual level socio-demographic characteristics, the effect of household poverty level no longer remained significant (Table 4a, model 1).

The prevalence of asthma diagnosis was 8.6% among children of mothers who had completed college or graduate school, 22.6% among children of mothers who had

completed some college or technical school, 21.4 % among children of mothers who were high school graduates or had attained a GED, and 23.2% among children of mothers who had not completed high school. In unadjusted analyses, children of mothers who had completed some college, completed some high school or a GED, or had not completed high school were significantly more likely to have received a diagnosis of asthma compared to those who had completed college or graduate school. After adjustment for socio-demographic characteristics and housing characteristics (Table 4a model 1 and Table 4b model 4) the relationship between education level and diagnosis of asthma was attenuated but remained significant. However, when neighborhood education level (% of adults who had obtained a bachelor's degree) was added to the model, the effect estimates for individual-level education were attenuated, and only one comparison (some college/technical school vs. college graduate/graduate school) remained significant (Table 4b model 6).

The rate of asthma diagnosis was 17.5% among children with private health insurance coverage, 22.3% among children who were covered under Medicaid, and 30.2% among children lacking health insurance coverage. In unadjusted analyses, both children on Medicaid and children with no insurance coverage were significantly more likely to have received a diagnosis of asthma compared to those who reported that they had private health insurance. After adjustment for socio-demographic and neighborhood characteristics, the relationship between Medicaid coverage and diagnosis of asthma was no longer significant. However, the relationship between lack of insurance coverage was attenuated but remained significant (Table 4a, Model 1). After further adjustment for

individual and neighborhood level factors, children lacking insurance coverage were significantly more likely to receive an asthma diagnosis compared to children with private insurance coverage.

4.II.A.iii. Results: Housing Characteristics

Prevalence of asthma diagnosis was significantly higher among children whose home exteriors had interviewer-observed evidence of peeling paint, crumbling walls, or broken windows, compared to children whose homes did not have any of these characteristics (29.5% vs. 18.9%). The prevalence of asthma diagnosis was also significantly higher among children whose home interiors had evidence of cracks or holes in the walls/ceiling, or evidence of rodents compared to children whose home interiors had none of these characteristics (29.1% vs. 20.2%). Prevalence of asthma diagnosis was also higher among children whose home interiors were dark, cluttered, crowded, noisy, or had evidence of trash or were unclean, compared to children whose home interiors had none of these characteristics (24.6% vs. 19.1%). However, after adjustment for the exterior condition of a child's home, variables measuring the interior conditions of the home were attenuated greatly, and no longer remained significantly related to diagnosis of asthma (Table 4a, model 2), suggesting a stronger effect between exterior measures of the home and asthma diagnosis. The relationship between exterior housing characteristics and asthma diagnosis was attenuated, but remained significant after multivariate adjustment for socio-demographic variables (Table 4bmodel 4). Finally, after further adjustment for individual and neighborhood characteristics, the relationship between poor exterior

conditions of the home and asthma diagnosis was not attenuated and remained significant.

4.II.A.iv. Neighborhood Characteristics

The prevalence of asthma diagnosis was higher among children living on blocks with graffiti, litter, vacant homes or deteriorating streets, compared to the prevalence of asthma among children living on blocks with no evidence of these characteristics (24.9% vs. 15.9%). In unadjusted analyses, the variable measuring poor conditions of the immediate block was significantly associated with asthma diagnosis. However, after adjustment for neighborhood level census tract variables, the relationship between conditions of the immediate block and asthma diagnosis was attenuated and no longer significant. Results of sensitivity analyses combining census tract variables into one index measuring neighborhood deprivation showed an association with asthma diagnosis in the bi-variate but not the multivariate analysis, thus we kept census tract variables as separate measures in order to determine which measures were most important.

Four of the five census tract variables considered in the analysis were associated with asthma diagnosis in unadjusted analyses (Table 3). On average, children who had received a diagnosis of asthma lived in census tracts where lower percentages of the population had a bachelor's degree, where a greater percentage of the housing units were vacant, where a greater percentage of families lived below the federal poverty line, and where a higher percentage of residents living in the area reported their race as non-Hispanic Black (data not shown). However, after controlling for other neighborhood

characteristics simultaneously, only one census tract variable, % of adult population with a Bachelor's degree, remained significantly related to asthma diagnosis (Table 3a, Model 3). The protective effect of this census tract variable was attenuated, but remained significant in models controlling for individual and housing characteristics (Table 3b, Models 5 and 6). We also tested whether census tract variables could be affecting asthma diagnosis through poor housing conditions, ie that housing conditions mediated the effect of neighborhood-level variables on asthma diagnosis. Comparing models 5 and 6, we see that the effect estimates for each of the census tract variables remain virtually the same – with or without the inclusion of housing characteristics. Thus, it appears that in our sample neighborhood characteristics and housing characteristics each exert independent effects on asthma diagnosis.

In the full multivariate model (Table 4b, Model 6) mother's race/ethnicity, insurance coverage, child's gender, hayfever, the physical condition of a child's exterior home, and the percent of the population with a bachelor's degree remained significantly associated with having received an asthma diagnosis by the age of 5 (Table 3b, Model 6). These 6 variables were also retained when automated forwards and backwards model selection techniques were used. No interactions were detected between any of the explanatory variables included in the multivariate model. In sensitivity analyses, multivariate logistic regression models were further adjusted for confounders previously found to be related to asthma diagnosis, including child's BMI, and prenatal care during pregnancy. However, adjusting for these variables did not change the results of the models shown in Table 2 substantially. Because of missing data on these variables, including them in the model

would cause the overall sample size to drop by greater than 200 observations. Therefore, these variables were not included in final models.

4.II.A.v. Stratification by Mother's Race/Ethnicity

In our sample, because Black and Puerto Rican race is highly correlated with economic disadvantage (Table 5), it is difficult to determine which factors are driving differences in the prevalence of asthma by race. In order to determine whether factors associated with asthma diagnosis differed among White, Black, and Puerto Rican children, we stratified multivariate models by mother's race/ethnicity (black and white). Among 948 children of mothers who reported their race as black, lack of insurance, male gender, and hayfever were significantly associated with a diagnosis of asthma, and poor housing was marginally significant (OR=1.45, 95% CI =0.99,2.10, p= 0.0549). However, among 342 children of mothers who reported their race as white, only education level was significantly associated with asthma diagnosis. Lack of insurance was marginally significant (OR=3.35, 95% CI =0.88, 12.78, p= 0.0772). The Puerto Rican sample was small (n=57), however, models restricted to children of Puerto Rican mothers showed that lack of reported health insurance was significantly related to asthma diagnosis (OR = 16.5, 95% CI 1.2,22.9.5).

4.II.A.vi. Alternative Definition of Outcome Variable: Asthma Attack

We substituted a health care provider's ever diagnosing asthma with a variable measuring whether or not a child had had an asthma attack in the last year. Just as in models using health care provider diagnosed asthma as an outcome, multivariate models with parent

report of asthma attack in the last year showed that children of mothers who identified their race as Non-Hispanic Black or Puerto Rican were more likely to report an asthma attack in the last year, compared to children of White mothers. Children living in housing with poor exterior conditions, those who were male, and those who had hayfever were also more likely to report an asthma attack in the last year compared to those who lived in housing with no sign of deteriorating exterior conditions, females, and those without hayfever. The relationship between lack of health insurance coverage and having an asthma attack in the last year was marginally significant ($p=0.0659$) in multivariate models. Finally, unlike when asthma diagnosis was used as an outcome, there was no relationship seen between having an asthma attack in the year prior to the 5 year visit and any of the census tract level variables from the census tract a child was living in at the time of his/her birth.

4.III. DISCUSSION

The objective of this analysis was to determine the association between individual, household, and neighborhood measures of economic disadvantage and asthma diagnosis among children living in urban areas across the U.S. In the final multivariate model which included both individual and neighborhood level data, we found several markers of economic disadvantage were independent predictors of reported asthma diagnosis in urban children by 5 years of age. Individual level predictors included the race/ethnicity and education level of a child's mother, lack of health insurance coverage for the child and the the physical condition of a child's home. Only one of the neighborhood level characteristics considered, the % of adults in a child's neighborhood that had obtained a

bachelor's degree, remained an independent predictor in the final model. The independent effect of individual, household, and neighborhood variables adds important evidence that efforts to identify and mitigate asthma in urban areas should be focused at both the individual and neighborhood level.

4.III.A. Neighborhood Economic Disadvantage

The relationships reported between markers of economic disadvantage and asthma diagnosis are similar to those found in other studies, however, the list of variables considered in our analysis is more comprehensive than those previously studied. In a similar analysis of the FCF data, Mother's race, child's gender, Medicaid, and living in a neighborhood with a) a high percentage of families living below the poverty line, b) a high percentage of housing that are rentals, and c) a high percentage of housing units built prior to 1940, were independent predictors of asthma diagnosis at *age 3* even after controlling for maternal medical risk factors[62]. Since previous research has shown that poor housing quality is related to increased exposure to indoor allergens known to trigger asthma, the authors of this analysis suggested that tract-level neighborhood characteristics may be serving as a proxy for either, 1) poor neighborhood safety and more time spent indoors or 2) an individual's own housing quality. However, their analysis contained no individual level measure of a child's housing quality as ours did[62]. We built on the 3 year FCF analysis by including both individual and census tract level measures of housing and poverty in the same model: we used detailed assessments of housing quality from the In-Home Longitudinal Study of Pre-School Aged Children, and incorporated assessments of the environment of a child's immediate block which would

exert a more proximal influence than census tract characteristics. We found that after controlling for individual level characteristics measuring housing quality and neighborhood safety, census tract level measures of housing vacancy and poverty as well as observed characteristics of the immediate block were no longer significant as in the FCF 3 year analysis. Thus, while measures of neighborhood housing quality and poverty level may act as effective *markers* for areas with high rates of asthma diagnosis, these variables may actually be related to asthma diagnosis through their relationship with individual level variables. Only one contextual level variable that we considered, educational level of the census tract, remained significant, even after adjusting for individual level education and other characteristics measured at individual and block level. Thus, the educational level of the neighborhood in which a child resides may be exerting an effect on asthma diagnosis in young urban children above and beyond the individual education level of a child's mother.

In sensitivity analyses we also examined whether the relationship between neighborhood education level and asthma diagnosis could be explained by residual confounding from variables not originally included in our models such as fewer prenatal care visits or reduced breastfeeding, factors previously shown to be associated with asthma and wheezing in the early years of life[62]. In our sample, mothers who reported no prenatal visits, on average, lived in census tracts with a lower percentage of adults with college educations, however, these differences did not reach statistical significance. Adding prenatal care to the model did not substantively change the relationship between

neighborhood education level and asthma, suggesting that these variables could not explain contextual level influences on asthma diagnosis.

Proposed theories explaining the independent influence of living in a disadvantaged neighborhood as a risk factor for asthma diagnosis include, 1) increased environmental exposures 2) increases in chronic stress (resulting in increased expression of and morbidity from disease)[12]. In our study, children living in neighborhoods with a lower % of adults who had obtained a bachelor's degree may be more likely to be exposed to both increased levels of environmental triggers and stress, either of which could lead to increased prevalence of wheeze (asthma-initiated or viral respiratory-initiated) resulting in an increased prevalence of asthma diagnosis.

4.III.B. Housing Quality

Our study showed that the prevalence of asthma was higher in homes with evidence of deteriorated conditions in the interior and exterior home environment. Previous literature has shown that housing with higher level of deterioration may contain higher loads of indoor allergens, which could in turn lead to increased sensitization and increased probability of developing asthma. In New York City, Rauh *et al* showed that levels of measured cockroach allergens (Bla g 2) were associated with the degree of housing disrepair (leaking pipes, holes in ceilings or walls, un-repaired water damage, interrupted heat or electrical service, paint chips/peeling paint), and that the proportion of frequent cockroach sightings increased with the level of housing deterioration. These relationships persisted, even after adjusting for the effects of income, ethnicity, and pest control

methods[36]. In a similar study carried out in Boston, Peters *et al* found that homes with clutter, lack of cleanliness, and holes in the wall or ceiling had elevated levels of cockroach allergen compared to other urban homes[37]. Thus, the conditions of the homes in which children are living may be linked to asthma through increased allergens and sensitization.

In our study, when measures of the interior and exterior environment were entered into the model together, only the exterior environment remained significant: after multivariate adjustment, children living in homes with evidence of peeling paint, crumbling walls, or broken windows - but not those with interior cracks in the walls or ceiling, evidence of rodents, clutter, and unclean conditions - were more likely to have received a diagnosis of asthma by five years of age. This finding is surprising as we would have expected interior conditions to exert a stronger influence on asthma diagnosis than exterior housing conditions and had hypothesized that deteriorating exterior conditions of the home should be related to asthma through its relationship with a more proximal factor such as deteriorating interior conditions. Further work is needed to determine the relationship between exterior housing quality, interior housing quality, and asthma diagnosis among children living in U.S. urban areas.

It s possible that the association seen between neighborhood and/or housing characteristics and asthma diagnosis could have been affected by the length of time that a child was exposed to a particular set of neighborhood or housing conditions. Thus, the impact of the role of a participant's length of residence was investigated using the variable *"Have you moved in the last 2 years?"* which was asked of mothers at the 5 year

visit. A substantial proportion, 47.8% of mother's interviewed, responded that they had moved their residence in the last 2 years. However, children of mothers who had moved in the last 2 years were *no more likely* to have received a diagnosis of asthma compared to children of mothers who had not moved in the last 2 years. (Chi-Sq = 0.558, p=0.4549, and children of mothers who had moved in the last 2 years were *no more likely* to be living in houses with poor exterior housing conditions (Chi-Sq = 0.132, p=0.716) or poor interior housing conditions (Chi-Sq = 1.396, p=0.238) compared to children of mothers who had not moved in the last 2 years. On average, mothers who reported that they had moved in the last 2 years lived in neighborhoods with a slightly lower percentage of adults who held a bachelor's degree, compared to children of mothers who had not moved in the last 2 years (15.2% with Bachelor's degree for those who had moved vs. 16.8% with bachelor's degree for those who had not, p=0.030).

While poverty, parent's education, or the education level of the neighborhood may be related to housing instability (ie mothers with fewer resources may have had to move more often), there is no evidence that moving affects the relationship between neighborhood or housing characteristics and asthma diagnosis. If mothers moved into neighborhoods and housing which was in similar condition to the ones that they left, associations between housing and neighborhood quality and asthma would likely have been minimally affected, if at all.

4.III.C. Mother's Race/Ethnicity

In our study sample, the odds of asthma among children of Mothers who identified their race as Non-Hispanic Black were 1.9 times, and as Puerto Ricans were 4.3 times those of

Non-Hispanic white mothers, after controlling for socio-demographic characteristics, insurance status, atopy, child's gender, and smoking. This finding replicates those in previous studies examining asthma in U.S. urban youth: in the Six Cities Study of air pollution and respiratory health, black children still had 1.6 times the odds of asthma diagnosis compared to white children, even after controlling for potential confounders such as cigarette smoke, BMI, air-conditioning use, city of residence, parental respiratory illness, parental education, being an only-child, and living in a single family household[66]. Leading hypotheses explaining racial differences in asthma include the influence of unmeasured socioeconomic factors (racial discrimination, differential access to medical care, housing, stress, and patterns of medical care use) as well as potential biologic factors such as genetic differences in susceptibility to environmental exposures[12]. While we attempted to control for socio-economic factors in our analysis, it is possible that residual confounding remained due to the close relationship between Black race and socio-economic disadvantage in our sample.

Some researchers support the hypothesis that genetic factors associated with African ancestry may be responsible for increased risk of asthma and high total serum IgE among black children[67]. However, numerous others have widely discounted genetic differences as a plausible explanation of racial and ethnic disparities in asthma, citing the low prevalence of asthma in black populations living in Africa[21, 68]. This fact, combined with evidence that the United States has some of the highest worldwide rates in asthma provides alternative evidence that the primary drivers of racial differences in asthma

prevalence are racial differences in environmental exposures, particularly *in utero* and early childhood exposures[21, 68].

It is possible that racial disparities in asthma diagnosis seen both in our sample and across the literature may be due to the fact that white children are less likely than minority residents to live in central city environments, and correspondingly less likely to experience heightened levels of allergen and particulate exposures along with community and individual stressors which increase vulnerability to these exposures[12]. A recent examination of data from the National Health Interview Study that showed that living in an urban setting is related to an increased the risk of asthma, regardless of race or income[21]. Further analyses have shown that a large portion of the increased prevalence of asthma among black children is attributable to socioeconomic factors such as living in the central city, income, low birth weight, and measures of overweight and obesity[69]. In our analyses, we saw an attenuation of the effect of race after adjusting for alternative socio-demographic characteristics. However, after adjustment for poverty, education, insurance coverage, housing condition and neighborhood factors, substantial differences in asthma prevalence by race still remained. While the FCF study was designed to include low-income, urban children from diverse ethnic backgrounds, a strong relationship between being of Black or Puerto Rican race and economic disadvantage remained. Thus we were unable to determine the extent to which mother's race exerts an influence on asthma diagnosis, above and beyond the socio-economic factors closely tied to race.

An alternative explanation for the persistence of racial and ethnic disparities in asthma diagnosis is the potential for "differential diagnosis" by race: *i.e.* minority children may be more likely than white children to receive a "diagnostic label" of asthma when presenting with a wheezing episode because of biases held by health care providers. Racial and ethnic differences in asthma diagnosis have been shown to exist – despite similarities in the prevalence of wheeze[70, 71]. In an analysis of data from the National Health Interview Study (NHIS), Akinbami and colleagues showed that, among children who reported wheezing in the last 12 months, black children were more likely to receive a diagnosis of asthma than white children - even after controlling for important factors such as reported symptom severity level, health insurance, and having a usual source of care[70].

In our sample, the prevalence of asthma was higher among Puerto Ricans, compared to both children of Non-Hispanic Black and Non-Hispanic White mothers. This finding is consistent with previous literature: surveillance programs and epidemiologic studies have consistently shown that Puerto Ricans have higher rates of both wheezing and asthma diagnosis than non-Hispanic whites[1], and this relationships has persisted even after controlling for important confounders such as smoking in the home or socioeconomic measures[72,70]. In our sample, the 57 mothers who identified their race as Puerto Rican were disproportionately sampled from Newark, NJ, New York, NY, and Philadelphia, PA. Overall 59.6% of Puerto Rican mothers in our sample came from these three cities (29.8% of Puerto Rican mother's were from Newark, and 29.8% were from New York. 19.3% were from Philadelphia, 5.0% from Milwaukee, 3.6% from Pittsburgh, 3.5% from

Detroit, 3.5% from Richmond, and 1.8% from Chicago). Thus, it is possible that the high rate of asthma diagnosis among Puerto Rican children in our sample may be attributable not only to Puerto Rican ethnicity, but also to environmental or health care factors associated with living in Philadelphia, New York, or Newark. While rates of asthma were higher in Newark, New York, and Philadelphia compared to the rest of the sample (23.3% for these 3 cities vs. 20.6% for all other cities, p= 0.2672), differences did not reach statistical significance. Further, controlling for living in one of these cities (vs. living in any of the other 17 cities) did not attenuate the relationship between Puerto Rican ethnicity and asthma diagnosis. This follow-up analysis was limited because of the small number of Puerto Ricans in our sample (only 12 Puerto Rican children in our sample lived in cities other than New York, Newark, or Philadelphia). Continued examination is needed into the high prevalence of asthma among Puerto Rican children living in urban areas in the Northeast U.S.

4.III.D. Insurance Coverage and Routine Care

In our analysis, mothers who reported that their child lacked private health insurance or Medicaid coverage were also more likely to report their child had received a diagnosis of asthma compared to those with private insurance, regardless of their racial or ethnic group. One explanation for this finding may be that young children presenting with wheeze or viral respiratory infections may be more likely to receive a diagnosis of asthma for their wheeze in certain health care setting than in others. Previous researchers have suggested that when children are assessed episodically by unfamiliar providers in urgent care settings (such as ER's) they may be more likely to receive a diagnostic label of

asthma for a wheezing episode. Urban children who have temporary and episodic interactions with the healthcare system may be more likely to be given a diagnosis of asthma to ensure treatment, whereas healthcare providers who are able to continuously observe a child's wheezing or coughing may be more conservative in diagnosing a child with asthma[2, 70]. Thus, FCF children with limited health insurance coverage may have received a diagnosis of asthma for a wheezing episode, regardless of whether the wheezing was due to true bronchial obstruction (asthma) or other factors which may cause wheeze (such as viral respiratory illnesses). Further examination of the relationship between insurance coverage and routine care in the FCF sample supports this hypothesis. The majority (97.7%) of mothers in the FCF study reported yes to the question, "*Does (child) have a usual place for routine health care, such as regular check-ups?*" Despite this high prevalence, differences in access to routine care still existed by insurance status. Compared to children with no health insurance, children covered by Medicaid or private insurance were 2.4 times (95% CI 1.0, 5.8) more likely to have a usual place for routine health care. When the same question was asked about the mother's source of routine care, differences were even greater: mothers who reported that they were covered by Medicaid or private insurance were 3.7 (95% CI 2.5, 5.6) times more likely to report that they had a routine place for medical care. Subsequent questions regarding access to routine care for the mother and child show that children and mothers in the FCF who lack health insurance may also have infrequent, episodic health care. Children lacking insurance coverage were more likely to report their usual place of health care as a walk-in clinic, ER care center, or "other" clinic (rather than a doctor's office or private clinic, and similar trends were seen when this question was asked about

a mother's place for usual care. Further, children with no insurance coverage were more likely to report that they had not been seen by a doctor or nurse for an illness in the last 12 months, and mothers with no insurance coverage were more likely to report that it had been more than 1 year since their last routine checkup.

4.III.E. Strengths and Limitations

This study had several strengths. The large sample size and variation of socio-demographic characteristics allowed examination of a broad array of markers of socio-economic disadvantage. Restriction of the sample to low-income, urban youth greatly reduced the possibility of confounding, and more importantly, allowed for a closer examination of factors related to high rates of asthma among an already at-risk group. Further, data available at individual, block, and neighborhood level, allowed for close examination of whether contextual level factors were working independently or serving as markers for individual level variables.

Along with these strengths, a number of limitations remain. First, because the study was conducted among urban children and unmarried mothers were over-sampled, the rates of asthma diagnosis are not necessarily representative of the general population. Despite adjustment for a broad array of socio-economic indicators, unmeasured or residual confounding may have existed. Further, because the conditions of a child's home and immediate neighborhood were measured at the five year visit, census tract variables were measured at the baseline visit, and asthma diagnosis could have occurred at any point up to the 5 year visit. Thus, the assumption must be made that the conditions of a

child's home or neighborhood remained consistent over time. The FCF was designed to measure social and psychosocial influences on health and development and did not include direct measures of indoor allergens and/or irritants. These measures would have helped to confirm whether children's housing and neighborhood characteristics were associated with diagnosis of asthma via increased exposure to allergens and particulates. Finally, while our study identified that Black and Puerto Rican children, those living in deteriorating housing in neighborhoods, and those with low education levels are at the highest risk for asthma, we are unable to tease out the difference between race and residence to determine which of these risk factors may be more important in the development of asthma. Further research is needed to distinguish between these two effects.

4.IV. Conclusion:

Our study showed associations between asthma diagnosis and individual socio-demographic characteristics, household deterioration, and neighborhood measures of economic disadvantage in a sample of young children living in 20 urban areas across the U.S. In multivariate models, we found that the race/ethnicity as well as the education level of a child's mother, lack of health insurance coverage, the physical condition of a child's home, and the % of adults in a child's neighborhood that had obtained a bachelor's degree were independent predictors of reported asthma diagnosis in urban children by 5 years of age. Our study is the first to document independent effects of individual, household, and neighborhood factors simultaneously in the same study. The independent effect of economic disadvantage, measured at each of these levels, provides

important evidence that efforts to identify and mitigate asthma in urban areas should be focused at the individual, household, and neighborhood level.

Figure 1: Flowchart outlining datasets combined to create study sample (manuscript 1)

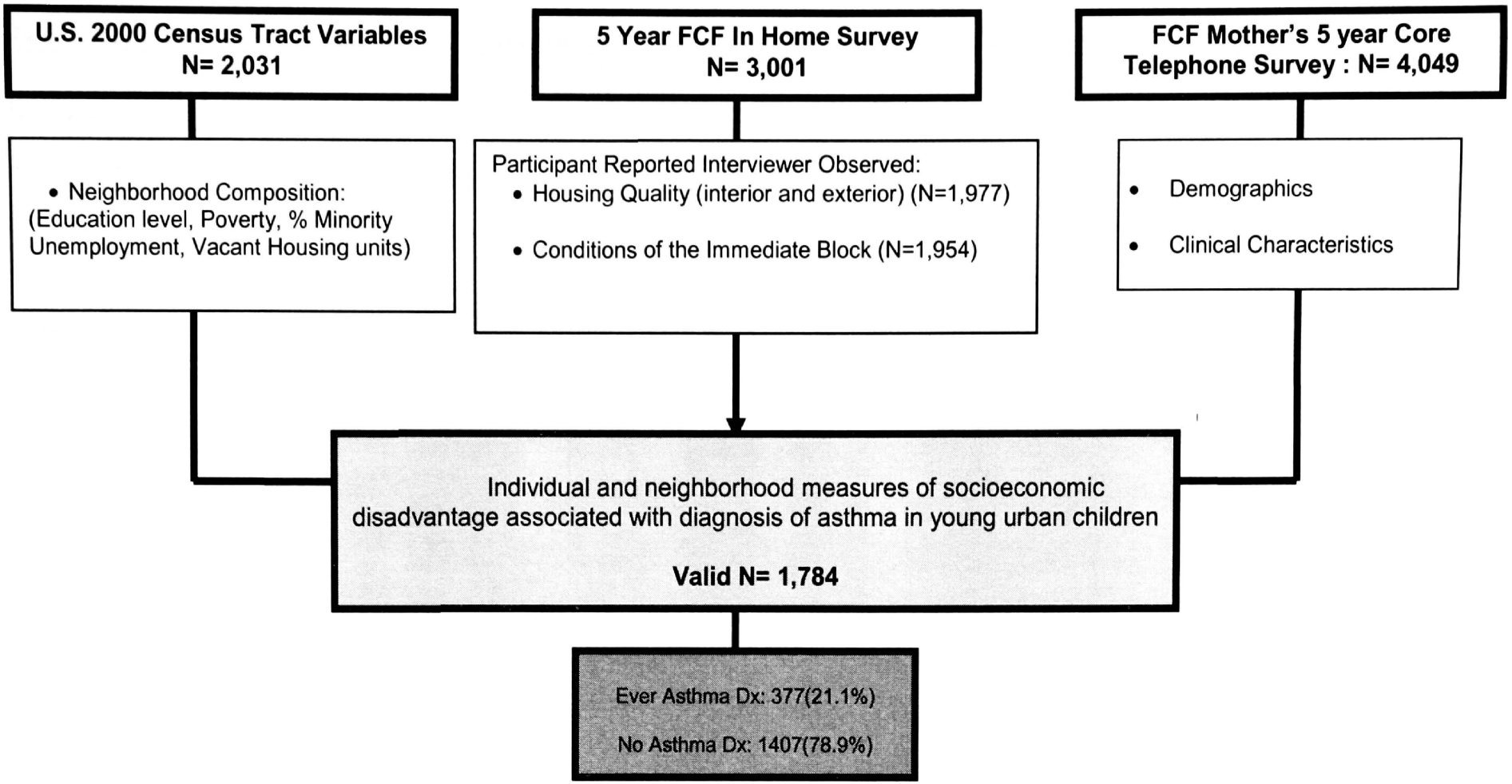


Table 1: Correlations between census tract variables considered for inclusion as neighborhood level effects

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0	% Vacant	% Renters	% Black	% Bachelor's	% High School	% Uemployed	% on Public assistance	% Below FPL
TM1PVACH Percent of housing units vacant	1	0.24464 <.0001	0.46216 <.0001	-0.35546 <.0001	-0.33389 <.0001	0.4912 <.0001	0.43764 <.0001	0.4801 <.0001
TM1PRENT Percent of occupied housing units renter-occupied	0.24464 <.0001	1	0.2728 <.0001	-0.23707 <.0001	-0.44969 <.0001	0.50679 <.0001	0.53312 <.0001	0.62484 <.0001
TM1PBLCK Percent of population non-Hispanic Black	0.46216 <.0001	0.2728 <.0001	1	-0.39005 <.0001	-0.23176 <.0001	0.55433 <.0001	0.45713 <.0001	0.48271 <.0001
TM1P25B Percent of 25+ population with bachelors or higher	-0.35546 <.0001	-0.23707 <.0001	-0.39005 <.0001	1	0.73813 <.0001	-0.54716 <.0001	-0.54768 <.0001	-0.57413 <.0001
TM1P25HS Percent of 25+ population with HS+ educ	-0.33389 <.0001	-0.44969 <.0001	-0.23176 <.0001	0.73813 <.0001	1	-0.65454 <.0001	-0.67362 <.0001	-0.73039 <.0001
TM1PUEMP Percent of civilian labor force (16+) unemployed	0.4912 <.0001	0.50679 <.0001	0.55433 <.0001	-0.54716 <.0001	-0.65454 <.0001	1	0.77629 <.0001	0.80467 <.0001
TM1PPUBA Percent of households on public assistance	0.43764 <.0001	0.53312 <.0001	0.45713 <.0001	-0.54768 <.0001	-0.67362 <.0001	0.77629 <.0001	1	0.81508 <.0001
TM1PFBPL Percent of families below poverty level in 1999	0.4801 <.0001	0.62484 <.0001	0.48271 <.0001	-0.57413 <.0001	-0.73039 <.0001	0.80467 <.0001	0.81508 <.0001	1

Table 2: Socio-demographic and clinical characteristics of the study sample (5 year FCF Visit), N=1,784

	N(%)
Child Diagnosed with asthma by 5 year visit	377(21.1%)
Child not diagnosed with asthma by 5 year visit	1407(78.9%)
Demographic and Clinical Characteristics	
Mother's Race/Ethnicity	
Non-Hispanic White	342(19.2%)
Non-Hispanic Black	953(53.1%)
Puerto Rican	57(3.2%)
Mexican	248(13.9%)
Other Hispanic	134(7.5%)
American Indian / Asian	47(2.6%)
Mother's Marital Status	
Unmarried at 5 year interview	1217(68.2%)
Married at 5 year interview	566(31.7%)
Household Income level (Median (IQR))	$24,142($11,000,$47,987)
HH Income: % of Federal Poverty Level	
300+%	321(18.0%)
100-299%	677(38.0%)
0-99% (below federal poverty level)	786(44.1%)
Mother's Education Level	
College graduate or graduate school	174(9.8%)
Some college or technical school	434(24.4%)
High School grad or GED	476(26.7%)
<Hs graduate	698(39.2%)
Child's insurance coverage	
Private Insurance	612(34.3%)
Medicaid	1,066(59.8%)
No Insurance coverage	106(5.9%)
Smoking	
No smokers inside the child's home	1045(58.7%)
1or more smokers inside the child's home	736(41.3%)
Child's Gender	
Female	857(48.0%)
Male	927(52.0%)
Child's Allergies	
No Hay Fever/Respiratory Allergies	1741(97.6%)
Hay Fever/Respiratory Allergies	42(2.4%)
Child has a usual place for routine health care such as regular check-ups	
Yes	1743(97.8%)
No	40(2.2%)
Place where child usually goes for health care	
Home	2(0.1%)
Doctor's office/private clinic/hmo	1325(74.4%)
Hospital outpatient clinic	306(17.2%)
Other clinic	127(7.1%)
Hospital emergency room	1(0.1%)
Walk-in/emergency care center	5(0.3%)
Other	16(0.9%)

'able 3: Individual, housing, and neighborhood characteristics of the study sample and city of baseline interview N =1,784)

Housing Characteristics	
Exterior Condition of Child's Home	
Exterior of Home in Good/Fair Condition	1411(79.1%)
Exterior of Home in Poor Condition‡	373(20.9%)
Interior Condition of Child's Home - Physical	
Interior of Home in Good/Fair Condition	1588(89.0%)
Interior of Home in Poor Condition††	196(11.0%)
Interior Condition of Child's Home - Social	
Interior of Home in Good/Fair Condition	1,116(62.6%)
Interior of Home in Poor Condition†††	668(37.4%)
Neighborhood Characteristics: Participant Reported / Observed	
Conditions of Immediate Block	
Block in Good/Fair Condition	1383(77.5%)
Block in Poor Condition†	401(22.5%)
Neighborhood Characteristics: Census Tract Data	
% 25+ population with Bachelor's Degree *median (IQR)*	10.9%(6.0%,20.6%)
% occupied housing units rentals *median (IQR)*	48.2%(32.7%,67.1%)
% housing units vacant *median (IQR)*	6.8%(4.1%,11.8%)
% population non-Hispanic Black *median (IQR)*	38.9%(5.1%,87.4%)
% Families < Federal Poverty Level *median (IQR)*	17.8%(8.0%,29.2%)
City of Baseline Interview	
Oakland, CA	48 (2.7%)
Austin, TX	46 (2.6%)
Baltimore, MD	164 (9.2%)
Detroit, MI	150 (8.4%)
Newark, NJ	111 (6.2%)
Philadelphia, PA	143 (8.0%)
Richmond, VA	138 (7.7%)
Corpus Christi, TX	121 (6.8%)
Indianapolis, IN	171 (9.6%)
Milwaukee, WI	183 (10.3%)
New York, NY	98 (5.6%)
San Jose, A	117 (6.6%)
Boston, MA	10 (0.6%)
Nashville, TN	6 (2.6%)
	40 (2.2%)
	20 (1.1%)
	58 (3.3%)
	53 (3.0%)
	47 (2.6%)
	46 (2.6%)

†Blocks in "Poor Condition" had interviewer-observed evidence of graffiti, litter, vacant homes, or nearby homes in poor condition.
‡Homes in "Poor Condition" had interviewer-observed evidence of peeling paint, crumbling walls, or broken windows.
††Home interiors in "Poor Condition" (physical) had interviewer-observed evidence of cracks or holes in the walls/ceiling, or evidence of rodents
†††Home interiors in "Poor Condition" (social) had interviewer-observed evidence of dark, cluttered, crowded, noisy, or unclean interiors

Table 4a: Individual, Housing and Neighborhood Characteristics Associated with Asthma Diagnosis by age 5 (N=1784)

	Bivariate Analysis		Multivariate Analysis		
	% With Asthma Diagnosis	Unadj. Odds Ratio (95%CI)	Model 1^ Adj. OR (95%CI)	Model 2^^ Adj. OR (95%CI)	Model 3^^^ Adj. OR (95%CI)
Socio-Demographic Characteristics					
Mother's Race/Ethnicity					
Non-Hispanic White	12.6%	1.0(ref)	**1.0(ref)**	---	---
Non-Hispanic Black	23.7%	2.16(1.52,3.08)**	**1.88(1.28,2.76)****	---	---
Puerto Rican	40.4%	4.70(2.53,8.73)**	**4.34(2.25,8.37)****	---	---
Mexican	17.7%	1.50(0.95,2.34)	1.28(0.78,2.09)		
Other Hispanic	24.6%	2.27(1.37,3.77)*	**1.97(1.16,3.33)***		
American Indian/Asian	12.0%	1.43(0.63,3.26)	1.25(0.54,2.93)		
HH income: % of Federal Poverty Level					
300+%	15.9%	1.0(ref)	1.0(ref)	---	---
100-299%	21.4%	1.44(1.02,2.04)*	0.97(0.63,1.52)	---	---
0-99% (below federal poverty level)	23.0%	1.58(1.12,2.22)**	1.00(0.63,1.52)	---	---
Mother's Education Level					
College graduate or graduate school	8.6%	1.0 (ref)	**1.0 (ref)**	---	---
Some college or technical school	22.6%	3.09(1.74, 5.49)**	**2.50(1.35,4.65)****	---	---
High School grad or GED	21.4%	2.89(1.63,5.12)**	**2.00(1.04,3.82)***	---	---
<Hs graduate	23.2%	3.20(1.83,3.59)**	**2.18(1.14,4.17)***	---	---
Child's health insurance coverage					
Private Insurance	17.5%	1.0 (ref)	**1.0(ref)**	---	---
Medicaid	22.3%	1.36(1.05, 1.75)*	1.04(0.77,1.42)	---	---
No Insurance coverage	30.2%	2.04(1.28, 3.25)**	**1.86(1.13,3.05)***	---	---
Smoking					
No smokers inside the child's home	19.6%	1.0(ref)	1.0(ref)	---	---
1+ smokers inside the child's home	23.4%	1.25(0.99,1.57)	1.16(0.91,1.48)	---	---
Child's gender					
Female	16.9%	1.0(ref)	**1.0(ref)**	---	---
Male	25.0%	1.63(1.29,2.07)**	**1.71(1.35,2.17)****	---	---
Child's Allergies					
No Hay Fever/Respiratory Allergies	20.6%	1.0(ref)	**1.0(ref)**	---	---
Hay Fever/Respiratory Allergies	40.5%	2.62(1.40,4.90)**	**2.97(1.55,5.69)****	---	---
Housing Characteristics					
Exterior Condition of Child's Home					
Exterior of Home in Good/Fair Condition	18.9%	1.0(ref)	---	**1.0(ref)**	---
Exterior of Home in Poor Condition‡	29.5%	1.79(1.38,2.32)**	---	**1.61(1.19,2.18)***	---
Interior Condition of Child's Home - Physical					
Interior of Home in Good/Fair Condition	20.2%	1.0(ref)	---	1.0(ref)	---
Interior of Home in Poor Condition††	29.1%	1.63(1.17,2.26)**	---	1.14(0.78,1.67)	---
Interior Condition of Child's Home - Social					
Interior of Home in Good/Fair Condition	19.1%	1.0(ref)	---	1.0(ref)	---
Interior of Home in Poor Condition†††	24.6%	1.38(1.10,2.26)**	---	1.18(0.92,1.51)	---
Neighborhood Characteristics: Participant Reported / Observed					
Conditions of Immediate Block					
Block in Good/Fair Condition	15.9%	1.0(ref)	---	---	1.0(ref)
Block in Poor Condition†	24.9%	1.61(1.1, 2.26)	---	---	1.30(0.95,1.78)
Neighborhood Characteristics: Census Tract Data					
% 25+ population with Bachelor's Degree		0.07(0.02,0.19)**	---		**0.09(0.03,0.34)****
% occupied housing units rentals		1.51(0.93,2.46)	---		1.04(0.52,2.03)
% housing units vacant		10.81(2.37,49.24)**	---		2.07(0.33,13.08)
% population non-Hispanic Black		1.56(1.16,2.11)**	---		1.05(0.73,1.50)
% Families < Federal Poverty Level		4.02(1.90,8.50)**	---		0.85(0.23,3.14)
R-square			0.0711	0.0182	0.0286
AIC			1781.92	1827.01	1818.42

*p<0.05 **p<0.01. ^Model 1 includes socio-demographic characteristics only. ^^Model 2 includes housing characteristics only. ^^^Model 3 includes census tract and block characteristics, only. †Blocks in "Poor Condition" had interviewer-observed evidence of graffiti, litter, vacant homes, or nearby homes in poor condition. ‡Homes in "Poor Condition" had interviewer-observed evidence of peeling paint, crumbling walls, or broken windows. ††Home interiors in "Poor Condition" (physical) had interviewer-observed evidence of cracks or holes in the walls/ceiling, or evidence of rodents †††Home interiors in "Poor Condition" (social) had interviewer-observed evidence of dark, cluttered, crowded, noisy, or unclean interiors

Table 4b: Individual, Housing, and Neighborhood Characteristics Associated with Asthma Diagnosis by age 5

	Bivariate Analysis		Multivariate Analysis	
	% With Asthma Diagnosis	Unadj. Odds Ratio (95%CI)	Model 4^^ Adj. OR (95%CI)	Model 5^^^ Adj. OR (95%CI)
Socio-Demographic Characteristics				
Mother's Race/Ethnicity				
Non-Hispanic White	12.6%	1.0(ref)	1.0(ref)	1.0(ref)
Non-Hispanic Black	23.7%	2.16(1.52,3.08)**	1.81(1.23,2.66)**	1.88(1.17,3.02)**
Puerto Rican	40.4%	4.70(2.53,8.73)**	4.50(2.3,8.68)**	4.53(2.29,8.96)**
Mexican	17.7%	1.50(0.95,2.34)	1.33(0.81,2.18)	1.32(0.80,2.17)
Other Hispanic	24.6%	2.27(1.37,3.77)*	2.01(1.18, 3.42)*	1.93(1.12,3.32)*
American Indian/Asian	12.0%	1.43(0.63,3.26)	1.27(0.54,2.98)	1.45(0.61,3.47)
HH income: % of Federal Poverty Level				
300+%	15.9%	1.0(ref)	1.0(ref)	1.0(ref)
100-299%	21.4%	1.44(1.02,2.04)*	1.08(0.69,1.70)	1.20(0.76,1.89)
0-99% (below federal poverty level)	23.0%	1.58(1.12,2.22)**	1.07(0.71,1.61)	1.17(0.78,1.76)
Mother's Education Level				
College graduate or graduate school	8.6%	1.0 (ref)	1.0 (ref)	1.0 (ref)
Some college or technical school	22.6%	3.09(1.74, 5.49)**	2.49(1.34,4.62)**	2.16(1.14,4.06)*
High School grad or GED	21.4%	2.89(1.63,5.12)**	1.95(1.02,3.74)*	1.66(0.85,3.21)
<Hs graduate	23.2%	3.20(1.83,3.59)**	2.09(1.09,4.00)*	1.75(0.91,3.40)
Child's health insurance coverage				
Private Insurance	17.5%	1.0 (ref)	1.0(ref)	1.0(ref)
Medicaid	22.3%	1.36(1.05, 1.75)*	1.03(0.76, 1.40)	1.01(0.74,1.38)
No Insurance coverage	30.2%	2.04(1.28, 3.25)**	1.83(1.11,3.00)*	1.76(1.07,2.90)*
Smoking				
No smokers inside the child's home	19.6%	1.0(ref)	1.0(ref)	1.0(ref)
1+ smokers inside the child's home	23.4%	1.25(0.99,1.57)	1.12(0.87,1.43)	1.08(0.84,1.39)
Child's gender				
Female	16.9%	1.0(ref)	1.0(ref)	1.0(ref)
Male	25.0%	1.63(1.29,2.07)**	1.68(1.33,2.14)**	1.68(1.32,2.14)**
Child's Allergies				
No Hay Fever/Respiratory Allergies	20.6%	1.0(ref)	1.0(ref)	1.0(ref)
Hay Fever/Respiratory Allergies	40.5%	2.62(1.40,4.90)**	2.95(1.54,5.66)**	2.96(1.53,5.71)**
Housing Characteristics				
Exterior Condition of Child's Home				
Exterior of Home in Good/Fair Condition	18.9%	1.0(ref)	1.0(ref)	1.0(ref)
Exterior of Home in Poor Condition‡	29.5%	1.79(1.38,2.32)**	1.47(1.08,2.01)*	1.46(1.06,2.00)
Interior Condition of Child's Home - Physical				
Interior of Home in Good/Fair Condition	20.2%	1.0(ref)	1.0(ref)	1.0(ref)
Interior of Home in Poor Condition††	29.1%	1.63(1.17,2.26)**	1.09(0.74,1.62)	1.10(0.74,1.63)
Interior Condition of Child's Home - Social				
Interior of Home in Good/Fair Condition	19.1%	1.0(ref)	1.0(ref)	1.0(ref)
Interior of Home in Poor Condition†††	24.6%	1.38(1.10,2.26)**	1.07(0.82, 1.39)	1.06(0.81, 1.380
Neighborhood Characteristics: Participant Reported / Observed				
Conditions of Immediate Block				
Block in Good/Fair Condition	15.9%	1.0(ref)	---	1.0(ref)
Block in Poor Condition†	24.9%	1.61(1.1, 2.26)	---	1.06(0.76,1.50)
Neighborhood Characteristics: Census Tract Data				
% 25+ population with Bachelor's Degree		0.07(0.02,0.19)**		0.17(0.04,0.70)*
% occupied housing units rentals		1.51(0.93,2.46)		---
% housing units vacant		10.81(2.37,49.24)**		1.88(0.27,13.14)
% population non-Hispanic Black		1.56(1.16,2.11)**		0.81(0.48,1.35)
% Families < Federal Poverty Level		4.02(1.90,8.50)**		1.21(0.30,4.87)
R-square			0.0804	0.0901
AIC			1776.76	1775.198

*p<0.05 **p<0.01. ^Model 4 includes individual-level socio-demographic and housing characteristics only. ^^Model 5 includes individual-level socio-demographic, housing characteristics, interviewer observed / participant reported neighborhood characteristics, and census-tract level neighborhood variables †Blocks in "Poor Condition" had interviewer-observed evidence of graffiti, litter, vacant homes, or nearby homes in poor condition. ‡Homes in "Poor Condition" had interviewer-observed evidence of peeling paint, crumbling walls, or broken windows. ††Home interiors in "Poor Condition" (physical) had interviewer-observed evidence of cracks

r holes in the walls/ceiling, or evidence of rodents†††Home interiors in "Poor Condition" (social) had interviewer-observed evidence of dark, cluttered, crowded, oisy, or unclean interiors

Table 5: Relationships between Mother's Race/Ethnicity and markers of economic disadvantage

	Non-Hispanic White	Non-Hispanic Black	Puerto Rican	P
HH income: % of Federal Poverty Level				<0.0001
300+%	158(46.2%)	92(9.7%)	5(8.8%)	
100-299%	114(33.3%)	364(38.2%)	29(50.9%)	
0-99% (below federal poverty level)	70(20.5%)	497(52.2%)	23(40.4%)	
Mother's Education Level				
College graduate or graduate school	107(31.3%)	34(3.6%)	2(3.6%)	<0.0001
Some college or technical school	104(30.4%)	230(24.2%)	3(5.4%)	
High School grad or GED	66(19.3%)	304(31.9%)	17(30.4%)	
<Hs graduate	65(19.0%)	384(40.3%)	34(60.7%)	
Child's health insurance coverage				<0.0001
Private Insurance	206(60.2%)	255(26.8%)	17(29.8%)	
Medicaid	117(34.2%)	655(68.7%)	34(59.7%)	
No Insurance coverage	19(5.6%)	43(4.5%)	6(10.5%)	

›-values for Chi-square test of association

Chapter 5: Psychosocial stressors and ER utilization for asthma in young urban children

The purpose of this study was to examine the cross-sectional relationship between factors in the social environment (psychosocial stressors, neighborhood social environment, and socio-demographic characteristics), and Emergency Room (ER) or urgent care facility use for asthma in young urban children. In sensitivity analyses, we examined whether the results differed when report of asthma exacerbation in the last year was substituted for Emergency Room (ER) or urgent care facility use.

5.I. METHODS

5.I.A. Study Sample

The Fragile Families and Child Wellbeing Study (FCF) is a longitudinal, prospective cohort of 4,898 U.S. children born in over 20 large cities since 1998 (unmarried mothers were over-sampled). Baseline data was collected at the time of the child's birth, and follow-up telephone interviews were conducted in 3 and 5 year follow-up waves. A flow chart outlining the study sample used for this analysis is shown in Figure 1. Questions regarding a mother's demographic characteristics, access to medical care, and overall health were taken from the 5 year Core Telephone Survey. Questions on the Neighborhood Social Environment, Child Behavior Problems, Exposure to Violence (ETV), and Mother's Stress, Social Support, and Personal Mastery (coping) were taken from the 5 year In Home survey. All interviews were conducted between 2003 and 2006. Children were eligible for inclusion in the study sample if their mothers had completed both the 5 year Core Telephone Survey and the 5 year visit of the In-Home Longitudinal Study of Pre-School Aged Children, and if their mothers had answered "Yes" when asked whether or not their child had experienced an asthma attack in the last year (N=237). Children were eligible for inclusion in the sensitivity analysis if their mothers had completed both the 5 year Core Telephone Survey and the 5 year visit of the In-Home Longitudinal Study of Pre-School Aged Children, and if their mothers had answered "Yes" when asked whether or not their child had experienced an asthma attack in the last year (N=237).

5.I.B. Outcome Measures

As shown in Figure 1, the outcome variable for the primary analysis was defined as *whether or not a child with asthma had visited the ER or urgent care facility for an asthma attack in the 12 months preceding the five year visit.* Because of the structure of the skip patterns in the survey, the first question (ER or urgent care use) was only answered among caregivers who answered "yes" to the question, *"During the past 12 months has your child had an episode of asthma or an asthma attack?*[6]*"* This definition retained a sample size of 237 children who had experienced an asthma attack in the last year: 125 (52.7%) had visited the ER for asthma, while 112 47.3%) had not.

In sensitivity analyses, the outcome variable was changed to *whether or not an asthmatic child had experienced an asthma attack in the last year.* Of the FCF sample, 610 mothers had ever been told by a doctor or other health professional that their child has asthma. Of these, 221(36.2%) of mothers reported that their child had experienced an asthma attack in the last year, and 389 (63.8%) reported that their child had not.

5.I.C. Explanatory Variables

The primary independent (explanatory) variables of interest included individual measures of psychosocial stress (child behavior problems, mother's stress, social support, self-efficacy and depression) and measures of the physical and social neighborhood environment (social cohesion, social control, and ETV), and socio-demographic characteristics. These measures are described in detail below.

5.I.C.i. Psychosocial Factors: Child

Child Behavior Problems

Child behavior problems were measured by *The Child Behavior Checklist (CBCL)*, a scale of child's behavioral function across multiple domains that measures symptoms of aggressive, withdrawn, and anxious/depressive behavior[73]. The CBCL has been widely used and has shown excellent reliability in previous studies (test-retest

[6] Skip patterns for the 5 year question differ from those from the 3 year visit. At the 3 year visit, all mothers were asked if their child had visited the ER for asthma, whether or not they had had an asthma attack in the last year. This change was made so that the 5 year questions would reflect skip patterns in the 2009 National Health Interview Survey

orrelation =.93, Cronbach's alpha = 0.96)[73, 74]. A subset containing 72 of the original 113 CBCL items was ncluded in the FCF study, and from these 72 items, 7 CBCL subscales were calculated. Subscales included: 1) Anxious/Depressed Behavior 2) Withdrawn Behavior 3) Attention Problems 4) Social Problems 5) Aggressive Behavior, and 6) Delinquent Behavior[63]. During the 5 year in-home visit, a question describing child behavior problems was read aloud to the mother, and she was asked to indicate whether the statement was not true (0 points), sometimes or somewhat true (1 point), or very true or often true of her child (2 points). Item scores were summed to create total and subscale scores, with a higher score indicating more problems with a child's behavior. CBCL subscales, Cronbach's alpha values, and the specific items assessed in each scale are shown in Table 5.A.

Table 5.A.: CBCL scales and items, FCF cohort, Year 5

Aggressive (20 items)	Withdrawn (9 Items)	Anxious/Depressed (14 Items)
Child agues a lot	Child would rather be alone than with others	Child complains of loneliness
Child brags or boasts	Child refuses to talk	Child cries a lot
Child is cruel, bullying, or mean to others	Child is secretive, keeps things to self	Child fears s/he might think/do something wrong
Child demands a lot of attention	Child is shy or timid	Child feels s/he has to be perfect
Child destroys his/her own things	Child stares blankly	Child feels or complains no one loves him/her
Child destroys things belong to his/her family or others	Child sulks a lot	Child feels others out to get him/her
He/She is disobedient at home	Child is underactive, slow moving, lacks energy	Child feels worthless/inferior
He/She is disobedient in school	Child is unhappy, sad, or depressed	Child is nervous, hing strung, or tense
Child is easily jealous	Child is withdrawn, doesn't get involve w others	Child is too fearful or anxious
He/She gets in many fights	**Alpha based on full sample: .60**	Child feels too guilty
Child physically attacks people		Child is self conscious or easily embarrassed
Child screams a lot		Child is suspicious
Child is showing off or clowning		Child is unhappy, sad, or depressed
Child is stubborn, sullen, or irritable		Child worries
Child has sudden changes in mood of feelings		**Alpha based on full sample: .68**
Child talks too much		
Child teases a lot		
Child has temper tantrums or hot temper		
Child threatens people		
Child is unusually loud		
Alpha based on full sample: .84		

Attention Problems (11 Items)	Social Problems (Full scale: 8 Items)	Delinquent Behavior (10 of 13 CBCL items)
Child acts too young for age	Child acts too young for age	Does not seem to feel guilty after misbehaving
Child can't concentrate	Child clings to adults or too dependent	Hangs around with others who get in trouble
Child can't sit still	Child does not get along with other kids	Lies or cheats
Child is confused or seems to be in a fog	Child gets teased a lot	Prefers being with older kids
Child daydreams or gets lost in his/her thoughts	Child not liked by other kids	Runs away from home
Child is impulsive or acts without thinking	Child is overweight	Sets fire
Child is nervous high strung, or tense	Child is poorly coordinated or clumsy	Steals at home
Child is nervous moment or twitching	Child prefers being with younger kids	Steals outside home
Child has poor school work	**Alpha based on full sample: .68**	Swears or uses obscene language
Child is poorly coordinated or clumsy		Vandalizes
Child stares blankly		**Alpha based on full sample: .49**
Alpha based on full sample: .74		

5.I.C.ii. Psychosocial Factors: Mother

Mother's Depression

Major depression at wave 5 was assessed using a modified version of the CIDI-SF short form A[75,76]. Briefly, mothers were asked whether they had feelings of dysphoria (depression) or anhedonia (inability to enjoy what is usually pleasurable) in the last year that lasted for two weeks or more, and if so whether the symptoms lasted most of the day and occurred every day of the two week period. If yes, they were asked more specific questions about 1) losing interest, 2) feeling tired, 3) change in weight, 4) trouble sleeping, 5) trouble concentrating, 6) feeling worthless, and 7) thinking about death. A mother was designated as "depressed" if her CIDI depression score met standard cutoffs for major depression[75,76].

Mother's Parenting Stress

Mother's parenting stress was assessed during the in-home interview using 12 items from the parenting stress index (PSI), a tool which has shown to have good validity and reliability in previous studies (Cronbach's alpha = 0.86)[77, 78]. Questions were rated on a five point Likert scale: strongly disagree (0) to strongly agree (4), and items were summed to create an overall score. Scores ranged from 0 to 48 with a higher score indicating higher levels of stress. Questions included from the PSI scale are shown in Table 5.B.

Table 5.B.: Parental Stress Index
You often have the feeling that you cannot handle things very well
You find yourself giving up more of your life to meet you child(ren)'s needs than you expected
You feel trapped by your responsibilities as a parent
Since having (CHILD) you have been unable to do new and different things
Since having (CHILD) you feel that ou are almost never able to do things you like to do
There are quite a few things that bother you about your life
Having (CHILD) has caused more problems than you expected in your relationship with men
You feel alone and without friends
When you go to a party, you usually expect to have a bad time
You are less interested in people that you used to be
You enjoy things less than you used to
You are unhappy with the last purachase of clothing you made for yourself

Mother's Social Support

Because high levels of stress can be "buffered" by coping skills (ie self-efficacy or mastery) and/or levels social support, data on these items was included. Mother's level of social support was assessed by the answer to the question, "Is there anyone you know you feel very close with/share confidences/feelings/depend on?" If mothers answered "No" to this question, they were designated as having low social support.

Mother's Self-efficacy

Mothers' self-efficacy was evaluated with a shortened, 5-item version of Pearlin & Schooler's "Personal Mastery Scale"[79], a tool that has been used widely in health research to measure self-efficacy and has been shown to exhibit good construct validity.[80] Mothers were asked to rate 4 statements on a 4-point (strongly agree, agree, disagree, strongly disagree) scale, and items were summed to create an overall score. Scores ranged from 0 to 15, with a higher score indicating lower self-efficacy / mastery. Table 5.C shows the items included in the scale.

Table 5.C.: Personal Mastery Scale
Do you agree that...
I have little control over the things that happen to me
There is really no way I can solve some of the problems I have
There is little I can do to change many of the important things in my life
I often feel helpless in dealing with problems
Sometimes I feel like I'm being pushed around

5.I.C.iii. Neighborhood Social Environment

Mothers' responses on 4 measures were used in assessment of the neighborhood social environment. Mothers were asked "How many of the families on your block do you know well?" (none, very few, some, most, almost all). This variable was then collapsed to create a binary response (none vs. all other responses). Other measures used to assess the neighborhood social environment included neighborhood social cohesion, neighborhood social control, and exposure to violence.

Exposure to Violence (ETV)

Exposure to Violence was assessed using 7 items from the "My Exposure to Violence Scale"[81]. Each exposure to violence question was asked using the format, *"in the past year have you...at least once?"* Because only a small subset of items from the original scale was used in the FCF study, a summary scale was not created. Instead, we assessed the relationship between each exposure to violence question and asthma outcomes. Table 5.D. shows the specific scale items which were included in the FCF study.

Table 5.D.: Exposure To Violence
In the past year have you...at least once?
1 Seen someone get hit, slapped, punched, or beaten
2 Been hit, slapped, punched, or beaten yourself
3 Seen someone else get attacked by someone with a weapon
4 Been attacked yourself by someone with a weapon
5 Seen someone else get shot at by someone
6 Been shot at yourself by someone
7 Seen someone get killed becauses of violence by someone

Factor analysis was used to determine which questions measured similar domains. A 3 factor structure was identified: Factor 1 included being shot at / being attacked by someone with a weapon / being slapped, punched, or beaten by someone. Factor 2 included seeing someone else get shot at by someone/seeing someone get killed because of violence by someone, and Factor 3 included seeing someone else getting beaten up/seeing someone else get attacked by someone. One question was chosen from each factor for potential inclusion in the multivariate model.

Neighborhood Social Cohesion and Social Control (Collective Efficacy)

Measures of Neighborhood Collective Efficacy were based on previously validated measures of social control and social cohesion[82]. Table 5.E. shows the 5 items included in the social control scale. Mothers were asked: *How likely is it that neighbors would intervene if:* (very likely =1, somewhat likely=-2, not likely =3, very unlikely =4)

Table 5.E.: Social Control Items
How likely is it that neighbors would intervene if...
1. Children were skipping school & hanging out in street?
2. Children were spray painting buildings w/graffiti?
3. Children were showing disrespect to an adult?
4. A fight broke out in front of the house?
5. The neighborhood fire station threatened/budget cut?

Table 5.F. shows the 5 items included in the social cohesion scale. Mothers were asked: *Do you agree that: (Strongly Agree =1, Agree=2, Disagree =3, Strongly Disagree =4):*

Table 5.F.: Social Cohesion Items
Do you agree that...
1. People around here are willing to help their neighbors
2. This is a close-knit neighborhood
3. Gangs are a problem in this neighborhood (reverse)
4. People in this neighborhood generally don't get along (reverse)
5. People in this neighborhood do not share the same values (reverse)

First, items 3, 4, and 5 on the social cohesion scale were reverse coded, and "Don't Know or Refused" responses were assigned a missing value. The answers given on each question were summed to create a crude total score. A calibrated total score was then calculated, which calibrated the total score to the number of questions that a person answered (to allow for the accurate calculation of a scale when data was missing). A scale was not calculated if an individual answered less than 3 questions on the respective scales. Finally, social control and social cohesion scores were summed to create an overall collective efficacy score. Because no previously validated cutpoints were available to define low levels of social control/social cohesion, scores were divided into tertiles based on the distribution of data in the sample. Tertiles were then collapsed into dichotomous variables (low vs. med/high) for analysis.

5.I.C.iv. Socio-Demographic Characteristics, Medical Care, and Health

Socio-demographic measures included household income as % of federal poverty threshold (calculated), mother's self-reported race/ethnicity, mother's education level, and child's gender. Because children

who have allergies are at a higher risk for developing asthma than non-allergic children, a measure of allergic status *(whether a child has had symptoms of hayfever or allergy in the last 12 months)* was measured and included as a covariate in all models. Access to medical care was measured by asking mothers whether or not the child had a usual place for routine health care, such as regular check-ups, and where this place was (home, doctor's office, hospital/outpatient clinic, emergency room, urgent care, or other clinic). A child's health insurance status was assessed at the 5 year visit by asking mothers whether they were covered by Medicaid (Yes/No), and if no, whether or not the child was covered by private health insurance (Yes/No). If a mother answered no to both of these questions, the child was assumed to lack health insurance coverage. Smoking status was assessed by asking mothers whether or not there was one or more people who smoked inside the home.

5.I.D. Statistical Analysis

Means with 95% confidence intervals, medians, and percentages were calculated for all variables, and the bivariate relationship was assessed between ER/urgent care use for asthma and all explanatory variables (socio-demographic, medical care, psychosocial factors, and the neighborhood social environment). In order to explore colinearity among explanatory variables, relationships between covariates were also assessed. Differences between continuous variables were assessed using t-tests for normally distributed data and Wilcoxon tests of medians for non-normally distributed data. Differences between dichotomous variables were assessed using Chi-Square tests, and correlations between continuous measures were assessed using spearman's correlation coefficients. Variables were dichotomized[7], and unadjusted odds ratio's and confidence intervals were calculated for explanatory variables of interest. Multivariate logistic regression models with maximum likelihood estimation were

[7]Validated cut-points from the literature were used wherever possible. If no cut-point was available, then low, medium and high categories were created based on the distribution of the data in the study sample (tertiles).

used to assess the relationship between the outcome and explanatory variables of interest as well as any interactions between explanatory variables. Results were then compared with the final model using forwards selection techniques to sequentially add variables to the model. In sensitivity analyses all statistical analyses were repeated to assess the relationship between explanatory variables of interest and whether or not an asthmatic child had an asthma attack in the last year.

5.II. RESULTS

5.II.A. Description of the Study Sample

The study sample consisted of children who were participants in both the 5-year FCF telephone survey and the 5 year in-home visit. The primary analysis was conducted among 237 children whose mothers had reported that they had experienced an asthma attack in the last year. Of these 237 children, 125(52.7%) had been to an ER or urgent care center for asthma in the last 12 months, 70 (29.5%) had private health insurance coverage, 151(63.7%) were covered under Medicaid, 16(6.8%) reported no health insurance coverage, and 159(67.1%) were males. In the study sample, 26 (11.0%) mothers reported their race as white, 141(59.5%) reported their race as black, and 18(7.6%) reported their race as Puerto Rican. Thirty-eight (16.1%) of mothers met CIDI criteria for having major depression, and 27(11.4%) reported that they did not have someone that they feel very close with / can share their feelings with. Ninety-four (39.7%) mothers had not graduated from high school, 60(25.3%) had completed high school or a GED, 64(27.0%) had completed some college or technical school, and 19(8.0%) were college graduates. The median household income for children included in the study sample was $27,000 (IQR $15,000, $48,000).

The sensitivity analysis was conducted among 610 children who had ever been diagnosed with asthma.

Of these 610 children, 221(36.2%) had experienced an asthma attack in the last year, 170 (27.9%) had private health insurance coverage, 394(64.6%) were covered under Medicaid, 46(7.5%) reported no health insurance coverage, and 377(61.8%) were males. In the study sample, 77 (12.6%) mothers reported their race as white, 351(57.5%) reported their race as black, and 46(7.5%) reported their race as Puerto Rican. Eighty-five (13.9%) mothers met CIDI criteria for having major depression and 65(10.7%) reported that they did not have someone that they feel very close with / can share their feelings with. Two hundred and sixty-four(43.3%) mothers had not graduated from high school, 151(24.8%) had completed high school or a GED, 157(25.7%) had completed some college or technical school, and 38(6.2%) were college graduates. The median household income for children included in the study sample was $25,000 (IQR $13,000, $48,000).

5.II.B. Bivariate Analysis

5.II.B.i. ER visits for Asthma and Patient Characteristics

Bivariate statistics of patient demographics by visits to the ER/urgent care facility for asthma are shown in Table 1 (socio-demographics, medical care, and health). Compared to mothers of children who had not visited an ER or urgent care facility for their child's asthma attack in the last year, mothers of children who did were significantly more likely to be black or Puerto Rican and to have had no college schooling (p-value <0.05 for dichotomized variable). Though the relationships between ER visits and other socio-demographic variables did not reach statistical significance, a higher percentage of children with ER visits (compared to those who did not visit the ER for asthma) lived in households with incomes below the poverty threshold, had one or more person who smokes inside the home, and were male. Insurance and having a routine place for health care did not appear to have any effect on the

relationship of whether or not a child visited the ER for asthma: nearly all children reportedly had a routine place for health care regardless of whether they had visited an ER / urgent care facility or not.

5.II.B.ii. ER visits for Asthma and Psychosocial Stressors

Bivariate statistics of psychosocial factors and the neighborhood social environment by visits to the ER/urgent care facility for asthma are shown in Table 2. Two psychosocial factors; child's behavior (withdrawn behavior scale) and neighborhood collective efficacy (social control and social cohesion), were significantly ($p<0.05$) associated with an asthmatic child visiting the ER or urgent care for asthma. Asthmatic children who visited an ER or Urgent Care facility for asthma had higher median scores on the withdrawn behavior domain of the Child Behavior Checklist ($p=0.0093$), and lower collective efficacy scores for both neighborhood social control *and* neighborhood social cohesion ($p=0.0140$ and $p=0.0149$, respectively). Though the relationships between ER visits and other psychosocial variables did not reach statistical significance, a higher percentage of children who had visited the ER for asthma also had a mother who reported ETV, in particular, seeing someone getting hit, slapped, punched, or beaten ($p=0.0720$), or seeing someone else get shot at by someone ($p=0.0611$). Compared to mothers of children who did not visit the ER for asthma, mothers of children who did visit had higher parenting stress scores, lower self-efficacy scores, and a higher percentage of depression and low social support; though none of these differences were statistically significant.

5.II.B.iii. Relationships between Covariates

Tables 3-6 show relationships between explanatory variables. Table 3 shows the relationships of each of the domains on the CBCL with stress and self-efficacy, mother's depression, ETV and the neighborhood social environment in the study. Children of mothers with higher parental stress, lower self-efficacy, and depression had correspondingly higher (worse) scores on every CBCL domain. Children of mothers

who had witnessed a shooting had higher scores in the aggressive and anxious behavior domains compared to children of mothers who had not witnessed a shooting. Children living in neighborhoods with low levels of social control had correspondingly higher levels of attention and social behavior problems, and children in neighborhoods with low levels of social cohesion had correspondingly high levels of aggressive, attention, anxiety, and social behavior problems.

Table 4 shows relationships between mother's stress, self-efficacy, depression, and exposure to violence and the neighborhood social environment. Mothers who reported high levels of parental stress, also reported correspondingly low levels of self-efficacy, and low levels of neighborhood social control and social cohesion. On average, levels of parental stress were higher - and self-efficacy was lower – among mothers who were depressed compared to those who were not. Mothers who had witnessed a shooting had higher levels of stress, lower levels of self-efficacy, were more likely to be depressed, and were more likely to live in neighborhoods with lower collective efficacy (social control and social cohesion). Social support was not related to exposure to violence, depression, or neighborhood collective efficacy.

Table 5 and Table 6 show the relationship between socio-demographic characteristics (mother's race, mother's education, and poverty) and study variables of interest. Mother's race was associated with greater poverty. Though differences did not reach statistical significance, mother's race was also related to whether she had witnessed a shooting ($p<0.10$), and neighborhood social control scores were higher (better) for children of White mothers compared to Black or Puerto Rican ($p<0.10$). No relationship was seen between mother's race and the presence of child behavior problems, nor was there any relationship between race and depression, race and stress, or race and self-efficacy.

Higher poverty was associated with mother's minority race, lack of education, depression, higher stress and self-efficacy, and lower levels of neighborhoods collective efficacy. A higher percentage of mothers who witnessed a shooting were below the poverty threshold compared to those who had not, though this relationship did not reach statistical significance. In each CBCL domain, mean child behavior scores were also higher (worse) in children who lived in households where the income was below the poverty level, however, these differences did not reach statistical significance in all domains.

Mother's low education level was associated with race, poverty, parental stress, and self-efficacy. Child behavior scores were higher (worse) in children whose mothers had low education, though these differences did not reach statistical significance in all domains. No relationship was seen between mother's education level and mother's depression, and relationships between mother's education level, neighborhood collective efficacy, and exposure to violence did not reach statistical significance.

5.II.C. Multivariate Models

Odds Ratios and 95% Confidence Intervals of factors hypothesized to be associated with ER or urgent care use for asthma are shown in Table 7. Only 2 variables measuring psychosocial stressors – child's withdrawn behavior and low neighborhood social control - were significantly associated with ER use. In unadjusted analyses, children whose score was in the highest tertile of the CBCL Withdrawn Behavior scale were more likely to have visited the ER for asthma in the last year compared to those with lower scores on the CBCL (Unadj. OR = 2.2, 95% CI: 1.2, 3.7). Also, children who lived in neighborhoods with the lowest level (tertile) of social control were more likely to have visited the ER for asthma in the last year compared to those with higher levels of social control (Unadj. OR = 2.3, 95% CI: 1.3, 4.1). After multivariate adjustment for socio-demographic covariates (mother's race, poverty

level, education, and health insurance status), the effect estimates changed very little: children whose score was in the highest tertile of the CBCL Withdrawn Behavior scale were more likely to have visited the ER for asthma in the last year compared to those with lower scores on the CBCL (Adj. OR = 2.7, 95% CI: 1.5, 5.0), and children who lived in neighborhoods with the lowest level (tertile) of social control were more likely to have visited the ER for asthma in the last year compared to those with higher levels of social control (Adj. OR = 2.4, 95% CI: 1.3, 4.6). Models that included adjustment for additional variables (hayfever, child's gender, mother's history of asthma) did not differ substantially from the model presented in Table 7.

Two socio-demographic variables, mother's race and mother's education level were significantly associated with child's ER use for asthma. Children whose mothers reported their race as Black, Mexican, or Puerto Rican were more likely to have visited the ER for asthma in the last year compared to children of mothers who reported their race as White (Adj. OR = 11.5, 95% CI: 3.4, 39.2 (Black), Adj. OR = 4.6, 95% CI: 1.0, 20.0 (Mexican), Adj. OR = 14.6, 95% CI: 3.0, 70.2 (Puerto Rican)). Children whose mothers had completed no college coursework were also more likely to have visited the ER for asthma in the last year, compared to children of mothers who had completed at least some college (Adj. OR = 2.2, 95% CI: 1.1, 4.5). No interaction was detected between any of the explanatory variables included in the multivariate model.

In sensitivity analyses, we then assessed the relationship between all explanatory variables and asthma attack in the last year among children who had been diagnosed with asthma by the 5 year visit. Despite the fact that the descriptive statistics in this population were similar to those in the primary analysis, results of multivariate models differed substantially. No statistically significant relationship was seen

between any of the psychosocial stressors and report of an asthma attack in the last year. Instead, being male or suffering from hay fever or respiratory allergies in the last 12 months, were associated with having an asthma attack (Adj. OR = 1.6, 95% CI: 1.1, 2.4 (male) and Adj. OR = 2.4, 95% CI: 1.6, 3.6 (hayfever)). Neither of these variables was associated with going to the ER for asthma in the primary analysis.

5.II.D. Proposed Conceptual Model

A proposed conceptual model summarizing the cross-sectional relationships between the primary outcome variable (ER visits for asthma), psychosocial factors, and sociodemographic variables is shown in Figure 2. Measures of mother's psychosocial stress were related to household poverty and low neighborhood collective efficacy, however, mother's psychosocial stressors were not significantly associated with whether or not a child visited the ER for asthma. Instead, socio-demographic measures (mother's lack of college education and minority race), and the neighborhood social environment in which a child lives *were* related to ER visits for asthma. Though the interconnectedness of these variables makes it difficult to determine how these socio-demographic measures are related to ER visits, it may be occurring through lack of resources needed to adequately manage a child's asthma, or lack of facilities other than the ER to utilize when a child has an asthma attack. The relationship between withdrawn behavior and ER visits for asthma appears to be occurring independently from socio-demographic measures, because withdrawn behavior was not related to race, poverty, or education level.

5.III. DISCUSSION

The purpose of this study was to examine the cross-sectional relationship between factors in the social environment (psychosocial stressors, neighborhood social environment, and socio-demographic

characteristics), and Emergency Room (ER) or urgent care facility use for asthma in young urban children. In order to distinguish between factors related to having an asthma exacerbation and those related to patterns of health care (ER or urgent care) utilization for asthma, we compared the results of the first analysis to a sensitivity analysis which examined factors related to having an asthma attack. In our primary analysis, we found that evidence of withdrawn behavior, race, education, poverty, and the neighborhood social environment were all independently related to ER utilization for asthma. In contrast, only male gender and hay fever or respiratory allergies were identified as risk factors for asthma attack in the last year. These analyses raise important questions as to why patterns of health care utilization for asthma – but not report of asthma attacks–are related to socio-demographic characteristics and measures of the social environment.

5.III.A. Psychosocial Factors

No statistically significant relationships were detected between the presence of psychosocial stressors (mothers) and either ER utilization or report of an asthma attack in the last year among children with asthma. These results are surprising, because previous studies have indicated that psychosocial stressors may interfere with caregivers' ability to care for the needs of young children with asthma. Bartlett and colleagues showed that depression among inner-city caregivers of children with asthma has been linked to both increased emergency department use[83] and worsened adherence to asthma therapy among their children[84]. In our study, depression, stress, low self-efficacy, and low social support were marginally higher among mothers of children who visited the ER for asthma, however differences did not reach statistical significance.

Our results showed that children exhibiting high levels of withdrawn behavior had increased odds of visiting the ER for an asthma attack compared to those with lower levels of withdrawn behavior. This finding is consistent with previous research which has shown that internalizing behavior problems (withdrawn, anxious, and sleep-disrupting behaviors) as measured by the CBCL, are more prevalent among asthmatic children compare to non-asthmatic children[85, 86]. Results from previous studies also suggest that the psychological effects of asthma may be reciprocal: children who struggle with asthma symptoms may have greater psychological difficulties, and these difficulties may then exert influences on the ability of parents - or children themselves – to effectively manage asthma further[53]. Thus, children with withdrawn behavior who frequently visit the ER for asthma may experience increased psychological distress from their asthma exacerbations, which may then increase the probability of having future exacerbations.

5.III.B. Socio-Demographic Characteristics

Our study showed that a mother's education and her race/ethnicity were associated with the use of an ER or Urgent Care facility for her child's asthma attack. This finding is consistent with several previous studies. In a sample of New York City schoolchildren, Stingone *et al* showed a strong relationship between minority status (Latino or Black) and ER use for asthma, and the relationship persisted after controlling for socio-economic, disease-related, and access to care factors[87]. An analysis of data from the 1996-2000 Medical Expenditure Panel Survey (MEP) showed that minority and low-income children used more urgent care and less preventive care for asthma[31]. While the reason for higher rates of ER use among minority children with asthma is unclear, it may be due to reduced access to regular preventive care for asthma and/or lack of prescriptions for, or under-use of, asthma medications. Previous research has shown that minority children have fewer visits to asthma specialists and fill fewer prescriptions for

asthma medications compared to white children[88]. In our study and throughout the literature; race, poverty, and the social environment remain closely intertwined, making it difficult to determine whether race, or factors associated with race are more influential in influencing asthma outcomes.

A parent's education level can affect his/her ability to help provide consistent, quality care for their child's chronic disease. Previous research has suggested that mothers with higher levels of education focus more on preventive care for their children's asthma and rely less on urgent care facilities[31, 89]. A parent's education level has been shown to have a protective effect on both visiting the ED for asthma[31] and under-use of controller medications for asthma[89]. It is possible that inner-city caregivers with low education levels may also have reduced access to asthma educational resources, which may create difficulty in managing their child's asthma at home. We could not test this hypothesis in our sample, because the FCF study did not include information about the medical management of a child's asthma (the extent to which a child followed an asthma action plan, medication usage, or asthma problem solving behaviors of the mothers). However, results from studies of other inner-city populations in the U.S. provide evidence to support this hypothesis. The National Cooperative Inner-City Asthma study (NCICAS) showed that when caregivers of inner-city children with asthma were asked problem-solving questions about what to do during an asthma attack, the majority of caretakers showed difficulty in providing medically desirable strategies and most reported one or more solutions that were medically *undesirable* such as breathing into a paper bag during an asthma attack[53]. During an acute asthma exacerbation, prompt action is required for stabilization and prevention of hospitalization and increased severity. It is possible that FCF mothers with lower education levels may have reduced understanding, confidence, and/or ability to implement effective problem-solving behaviors and manage their child's

asthma attack at home. Thus they may resort to ER facilities for treatment and management of their child's asthma.

While poverty has been identified as a risk factor for ER use for asthma in socio-economically diverse samples, we did not detect a strong association in our sample. Our findings may be explained by the fact that the FCF sample was restricted to low-income urban children, and mild gradients in poverty among already low-income children may not necessarily correspond to changes in health care utilization patterns. The lack of a relationship between health insurance status and ER use in our study may be due to the varied influences that insurance status has on ER utilization. Some mothers of children with private insurance may not use the ER because they have access to other doctors and specialists, and some mothers of children without insurance may not use the ER because they do not want to accumulate unaffordable medical bills.

5.III.C. Neighborhood Social Environment

In the FCF study sample, we saw an independent effect of low neighborhood social control, even after adjusting for individual level factors. Social control, a construct widely used in the sociological literature, has been defined as "the capacity of a group to regulate itself based on desired principles and to reach collective goals." The construct can be characterized by kinship networks and sets of formal and informal ties in a neighborhood[90, 91]. Low social control – along with other indicators of social capital – has previously been linked to poor population health for numerous chronic diseases[92], with proposed mechanisms including increased prevalence of health-compromising behaviors, reduced access to services, and increased psychosocial stressors [93]. In the FCF cohort, the fact that those who visit the ER for an asthma attack are more likely to live in neighborhoods with low levels of social control may

indicate that residents are unable to spare the time or resources to intervene on the behalf of the neighborhood, and mothers are unable to tap into resources - family members, neighbors, doctors, nurses, or clinics – which may assist in management of their child's asthma. This hypothesis is rooted in Maslow's theory of hierarchical needs, which outlines a five level pyramid of needs: (1) physiological, (2) safety, (3) belongingness, (4) self-esteem (competence and mastery), and (5) self-actualization. When an individuals' basic levels of needs are not met, he or she is less able to focus on fulfilling higher level needs, such as competence and mastery of chronic disease management.[94] FCF mothers of children with asthma who struggle with poverty, poor housing, lack of education and opportunity, and neighborhood crime and disorder, day to day management of a child's asthma must compete with meeting more basic needs lower on the pyramid.

Importantly, these analyses from FCF data showed that socio-demographic differences in ER use for asthma persist, despite that fact that nearly all (98%) caregivers report that their child has a routine place for medical care. This finding indicates a potential disconnect between reported *access* to preventive medical care and utilization of the ER for an exacerbation of asthma. Despite the fact that caregivers may report access to an outpatient center where they can take their child for routine care or immunizations, competing needs may still leave them ill-prepared to manage a child's chronic disease at home, and consequently more likely to rely on the ER as a resource for the management and treatment of an asthma exacerbation.

5.III.D. Strengths and Limitations

This study is strong in that it includes numerous, detailed measures of psychosocial measures in both children and their adult caretakers. Restriction of the sample to low-income, urban youth allowed for a

closer examination of factors related to ER use for asthma among an already vulnerable group. Despite these strengths, the results of this study should be interpreted with several limitations in mind. While we were able to identify psychosocial and socio-demographic factors associated with ER use for asthma, we were limited in our ability to test hypotheses on the mechanisms through which these variables may have been influencing asthma outcomes. The FCF study was designed to measure social and psychosocial influences on children's general health and development, thus detailed measures of asthma medication use and medical management were unavailable. The close relationship between race, education, poverty, and place make it difficult to confirm whether socio-demographic differences in ER utilization for asthma could be due to underlying differences in asthma severity and a combination of increased triggers, and/or increased susceptibility faced by poor, minority children living in neighborhoods with high levels of social disorder. Future studies which include large, heterogeneous samples with detailed information on psychosocial stressors, socio-demographics, medical management, asthma symptoms and ER use *and* hospitalization for asthma would help to confirm some of the proposed mechanisms from this study.

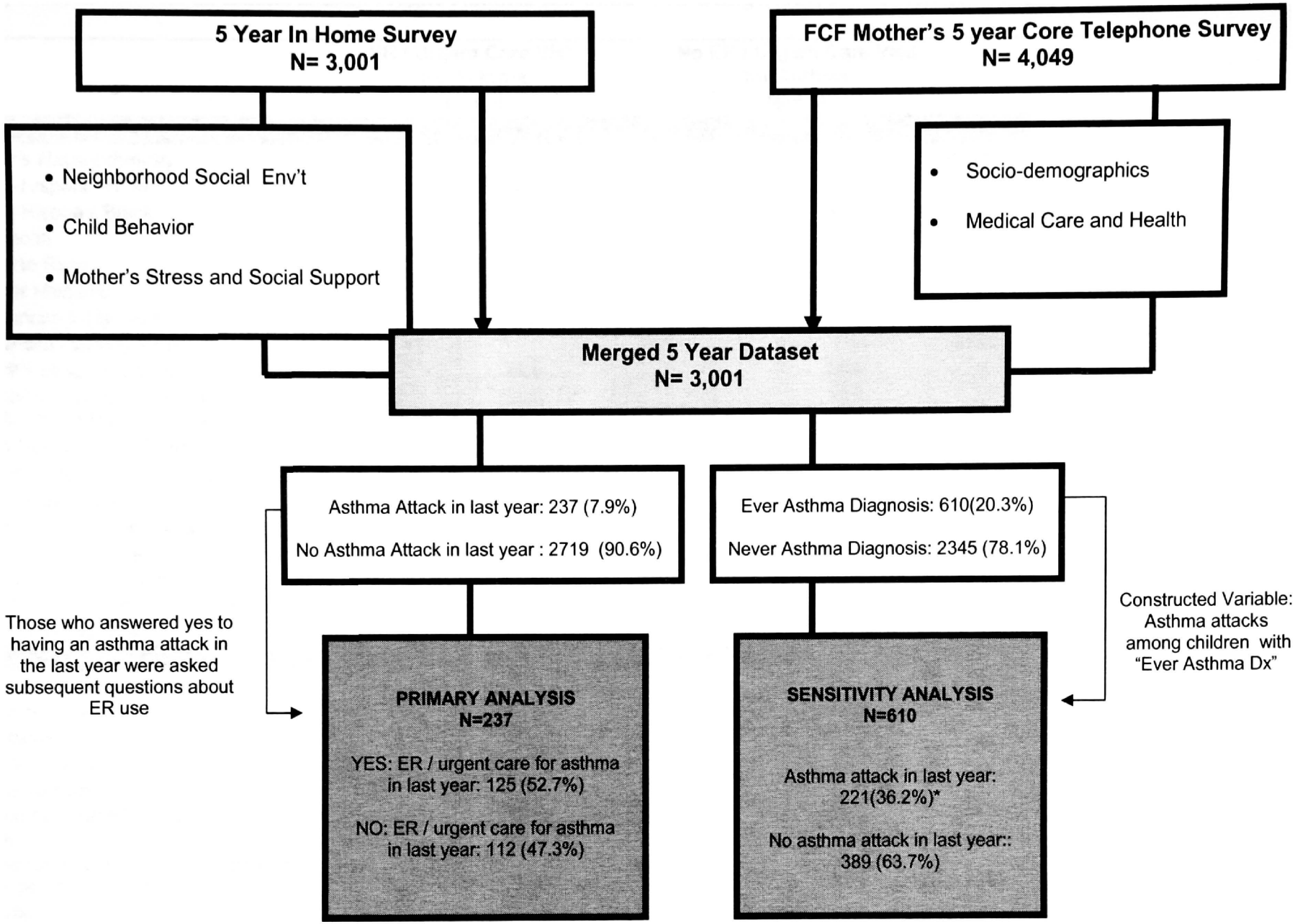
5.IV. Conclusion

One of the 6 major asthma care goals of the National Heart, Lung, and Blood Institute (NHLBI) is to prevent acute asthma exacerbations and minimize the need for emergency department visits or hospitalizations[95]. Yet, in our sample of young urban children with asthma, more than 50% of children who had an asthma attack in the last year also visited an ER or urgent care center for asthma. Management and treatment of asthma in the ER setting is undesirable for several reasons. First, the ER offers only short term treatment of symptoms rather than long-term management of the underlying

disease. Second, ER use for asthma management can be an inefficient use of health care resources compared to prevention and management in the primary care setting.

Based on findings from previous studies, we hypothesized that psychosocial factors would affect a mother's ability to effectively manage her child's asthma, and that depression, lack of social support, high stress, and low self-efficacy would increase the odds of ER visits for asthma and asthma attacks among urban youth. ER visits for asthma were associated with high levels of withdrawn behavior in children. However, we saw no strong relationship between mothers' psychosocial stressors and ER use. Instead, socio-demographic factors and measures of the neighborhood social environment were associated with increased odds of use of the ER for asthma. Further, among inner city youth, neither psychosocial factors nor socio-demographic characteristics increased the odds of an asthma attack in a child with asthma. Interventions which focus on effectively treating asthma symptoms should take into account the fact that some inner-city caregivers may lack knowledge, training, confidence and access to resources needed to effectively manage their child's asthma attack[94].

Figure 1: Flowchart of datasets included in psychosocial analyses (manuscript 2)



*16 children reported having an asthma attack for asthma, despite never receiving a diagnosis. Results from sensitivity analyses were conducted in which these 16 people were removed from the sample of 237, results did not differ from the main analysis

Table 1: Descriptive and bivariate statistics (*Demographic, Medical Care, and Health*) by visits to the ER/Urgent care facility for asthma (among children who had an asthma attack): Fragile Families and Child Well-Being Study, 5 year visit. (N=237)

	ER / Urgent Care Visit for Asthma N=125		No ER / Urgent Care Visit for Asthma N=112		
Socio-Demographic Characteristics	**N**	**%**	**N**	**%**	**P-value**
Mother's Race/Ethnicity					<0.0001
Non-Hispanic White	4	3.3	22	19.8	
Non-Hispanic Black	86	69.9	55	49.6	
Mexican	10	8.1	16	14.4	
Puerto Rican	13	10.6	5	4.5	
Other Hispanic	9	7.3	9	8.1	
American Indian/Asian	1	0.8	4	3.6	
Household Poverty Level					0.8229
0-49% of poverty threshold	27	21.6	29	25.9	
50-99% of poverty threshold	27	21.6	22	19.6	
100-199% of poverty threshold	39	31.2	27	24.1	
200-299% of poverty threshold	18	14.4	15	13.4	
300% + of poverty threshold	14	11.2	19	17.0	
Mother's Education					0.0629
Less than high school education	56	44.8	38	33.9	
High School or GED	35	28.0	25	22.3	
Some College or technical school	27	21.6	37	33.0	
College graduate/graduate school	7	5.6	12	10.7	
Male Gender (child)	85	68.0	74	66.1	0.7524
Medical Care and Health	**N**	**%**	**N**	**%**	**P-value**
Insurance Coverage					0.5976
Private Insurance	35	28.0	35	31.3	
Medicaid	83	66.4	68	60.7	
No Insurance	7	5.6	9	8.0	
Access to Care					
Child has place for routine health care	123	98.4	110	98.2	0.9118
Health					
Child had sx of Hayfever or respiratory allergies in last 12 mo.	35	28.0	41	37.3	0.1294
Smoking					
1 or more people smokes in the home	59	47.2	41	35.5	0.0992

p-value for Chi-square test of association

Table 2: Descriptive and bivariate Statistics (*Psychosocial Factors and Social Environment*) by visits to the ER/Urgent care facility for asthma (among children who had an asthma attack): Fragile Families and Child Well-Being Study, 5 year visit. (N=237)

	ER / Urgent Care Visit N=125		No ER / Urgent Care Visit N=112		
Psychosocial Factors: Mother	**N**	**%(mean,median)**	**N**	**%(mean,median)**	**P-value**
Stress (Parenting Stress Index Score): *mean(95% CI)*	125	14.1(12.4,15.8)	112	13.2(11.8,14.7)	0.4731
Self Efficacy (Parental Mastery Index): *median (IQR)*	125	3.0(1.0, 5.0)	112	2.0(1.0,5.0)	0.4071
Depression	21	16.8	17	15.2	0.7431
Low Social Support	16	12.8	11	9.8	0.4712
Psychosocial Factors: Child	**N**	**%(mean,median)**	**N**	**%(mean,median)**	**P-value**
Total Child Behavior Score (CBCL)	125	26.2(23.7, 28.6)	112	25.4(22.4, 28.5)	0.5336
Aggressive Behavior Score	125	11.0(9.9, 12.0)	112	11.5(10.1, 12.9)	0.5254
Withdrawn Behavior Score	125	2.9(2.4,3.3)	112	2.0(1.6,2.4)	0.0093
Anxious Behavior Score	125	3.9(3.3, 4.5)	112	3.4(2.8,3.9)	0.1997
Attention Problems	125	3.0(2.5, 3.5)	112	2.5(2.0, 3.1)	0.2306
Social Problems	125	2.3(2.0,2.7)	112	2.4(2.1,2.8)	0.7454
Delinquent Behavior	125	3.1(2.8, 3.4)	112	3.5(3.2, 3.9)	0.0673
Neighborhood Social Environment	**N**	**%**	**N**	**%**	**P-value**
Mother doesn't know anyone on block well	41	32.8	24	21.4	0.0501
Combined Neighborhood Social Control Score mean(95% CI)*	121	8.5(7.8,9.3)	111	10.0(9.0,10.9)	0.0140
Social Control: very/somewhat likelyneighbors would intervene if:					
Children were skipping school & hanging out in street?	69	55.2	74	66.1	
Children were spray painting buildings w/graffiti?	88	70.4	94	84.0	
Children were showing disrespect to an adult?	87	69.6	89	79.5	
A fight broke out in front of the house?	89	71.2	94	84.0	
The neighborhood fire station threatened/budget cut?	87	69.6	83	74.1	
Combined Neighborhood Social Cohesion Score mean(95% CI)*	122	9.9(9.2, 10.5)	109	10.8(10.2, 11.5)	0.0419
Social Cohesion: Strongly Agree/Agree that:					
People around here are willing to help their neighbors	81	64.8	84	75.0	
This is a close-knit neighborhood	66	52.8	73	65.2	
Gangs are a problem in this neighborhood (rev)	22	17.6	16	14.3	
People in this n'bhood generally don't get along (rev)	30	24.0	14	12.5	
People in this n'bhood do not share the same values (rev)	55	44.0	38	33.9	
Exposure to Violence (ETV)					
In the past year have you...at least once?					
Seen someone get hit slapped, punched or beaten	56	44.8	37	33.3	0.0720
Been hit slapped, punched or beaten yourself	9	7.2	5	4.5	0.3816
Seen someone else get attacked by someone with a weapon	17	13.6	13	11.7	0.6638
Been attacked yourself by someone with a weapon	4	3.2	1	0.9	0.2209
Seen someone else get shot at by someone	17	13.6	7	6.2	0.0611
Been shot at yourself by someone	1	0.8	1	0.9	0.9327
Seen someone get killed becauses of violence by someone	11	8.8	5	4.5	0.1902

Table 3: Relationship between covariates: Mother's stress, child's behavior, and neighborhood social environment among urban children who experienced an asthma attack in the last year: Fragile Children and Well-Being Study, 5 year visit (N=237)

	Stress and Self-Efficacy		Mother's Depression			Exposure To Violence			Neighborhood Social Env't	
	Parental Stress Index	Low Self-Efficacy	Mother Depressed (n=38)	Mother Not Depressed (n=199)	Depressed P-value	Mother witnessed a shooting (n=24)	Mother did not witness shooting (n=213)	Shooting P Value	Neighborhood Social Control	Neighborhood Social Cohesion
Child Behavior Checklist										
Aggressive Behavior	0.38994	0.31717	Dep.(mean)	Not Dep.(mean)	P-value	ETV(mean)	No ETV(mean)	P-value	0.11598	0.21236
	<.0001	<.0001	14.8(8.2)	10.5(6.2)	0.003	14(8.1)	10.9(6.5)	0.033	0.0779	0.0012
Withdrawn Behavior	0.27762	0.22723	Dep.(mean)	Not Dep.(mean)	P-value	ETV(mean)	No ETV(mean)	P-value	0.07625	0.07303
	<.0001	0.0004	3.9(2.4)	2.2(2.4)	<0.001	3.3(2.8)	2.4(2.4)	0.1043	0.2474	0.269
Anxious Behavior	0.39053	0.27736	Dep.(mean)	Not Dep.(mean)	P-value	ETV(mean)	No ETV(mean)	P-value	0.10794	0.16279
	<.0001	<.0001	5.1(3.6)	3.4(3.1)	0.0019	5.3(3.9)	3.5(3.1)	0.0083	0.101	0.0132
Attention Problems	0.34601	0.33947	Dep.(mean)	Not Dep.(mean)	P-value	ETV(mean)	No ETV(mean)	P-value	0.14928	0.18484
	<.0001	<.0001	3.9(3.3)	2.6(2.9)	0.0127	3.5(3.3)	2.7(3.0)	0.2455	0.0229	0.0048
Social Problems	0.30613	0.26908	Dep.(mean)	Not Dep.(mean)	P-value	ETV(mean)	No ETV(mean)	P-value	0.15981	0.16228
	<.0001	<.0001	3.7(2.5)	2.1(1.8)	0.0006	2.8(2.1)	2.3(2.0)	0.2921	0.0148	0.0135
Delinquent Behavior	0.19223	0.1765	Dep.(mean)	Not Dep.(mean)	P-value	ETV(mean)	No ETV(mean)	P-value	-0.04761	0.05643
	0.003	0.0064	3.2(2.2)	3(1.6)	0.0458	3.6(2.4)	3.3(1.7)	0.4797	0.4705	0.3932

Table 4: Relationship between covariates: Mother's stress, child's behavior, and neighborhood social environment among urban children who experienced an asthma attack in the last year: Fragile Children and Well-Being Study, 5 year visit (N=237)

	Stress and Self-Efficacy		Mother's Depression			Exposure To Violence			Neighborhood Social Env't	
	Parental Stress Index	**Low Self-Efficacy**	**Mother Depressed (n=38)**	**Mother Not Depressed (n=199)**	**Depressed P-value**	**Mother witnessed a shooting (n=24)**	**Mother did not witness shooting (n=213)**	**Shooting P Value**	**Neighborhood Social Control**	**Neighborhood Social Cohesion**
Parental Stress Index		0.62418	Dep.(mean)	Not Dep.(mean)	P-value	ETV(mean)	No ETV(mean)	P-Value	0.23684	0.17004
		<.0001	19.0(10.3)	12.7(3.9)	<0.0001	17(10.4)	13.3(8.6)	0.0500	0.0003	0.0096
Mother's Low Self-Efficacy	0.62418		Dep.(mean)	Not Dep.(mean)	P-value	ETV(mean)	No ETV(mean)	P-Value	0.21975	0.13843
	<.0001		4.3(8.2)	3.0(3.2)	0.0246	4.7(4.0)	3.1(3.2)	0.0197	0.0008	0.0355
Mother's Depression	mean	mean				ETV	No ETV	P-Value	mean	mean
Depressed (n=38)	19(10.3)	4.3(3.9)				66.7%	85.9%	0.0148	9.7(4.8)	11.1(3.7)
Not Depressed (n=199)	12.7(8.2)	33.0(3.2)				33.3%	14.1%		9.2(4.5)	10.2(3.4)
P-value	<0.0001	0.0246							0.504	0.149
Mother's Social Support	mean	mean	Dep	No Dep	P-value	ETV	No ETV	P-Value	mean	mean
No one to Depend On (n=27)	14.6(7.8)	3.9(3.5)	0.0%	86.4%	0.0159	12.5%	11.3%	0.8573	9.8(3.7)	10.7(2.9)
Someone to Depend On (n=210)	13.6(9.0)	3.1(3.3)	100.0%	13.6%		87.5%	88.7%		9.2(4.6)	10.3(36)
P-value	0.5523	0.2308							0.508	0.609
Neighborhood Social Environment										
Exposure to Violence	ETV(mean)	No ETV(mean)	Dep	No Dep	P-value				ETV(mean)	No ETV(mean)
Mother witnessed a shooting (n=24)	17.0(10.4)	4.7(4.0)	21.10%	8.0%	0.0148				10.9(5.4)	12.2(4.0)
Did not witness a shooting (n=213)	13.3(8.6)	3.1(3.2)	78.90%	92.0%					9.1(4.4)	10.2(3.4)
P-value	0.0500	0.0197							0.0660	0.0260
Low Neighborhood Social Control	0.23684	0.21975	Dep.(mean)	Not Dep.(mean)	P-value	ETV(mean)	No ETV(mean)	P-Value		
	0.0003	0.0008	9.7(4.8)	9.19(4.3)	0.504	10.9(5.4)	9.1(4.4)	0.0660		
Low Neighborhood Social Cohesion	0.17004	0.13843	Dep.(mean)	Not Dep.(mean)	P-value	ETV(mean)	No ETV(mean)	P-Value		
	0.0096	0.0355	11.1(3.7)	10.22(3.8)	0.149	12.2(4.0)	10.2(3.4)	0.0260		

Table 5: Relationship between covariates: Socio-demographic characteristics and neighborhood social environment among urban children who experienced an asthma attack in the last year: Fragile Children and Well-Being Study, 5 year visit (N=237)

	Percent of Poverty Threshold				Exposure to Violence			Neighborhood Social Env't	
Ethnicity	0-99%	100-299%	300%+	Poverty P-Value	Mother witnessed a shooting (n=24)	Mother did not witness shooting (n=213)	Shooting P-Value	Social Control	Social Cohesion
	n(%)	n(%)	n(%)	<0.0001	n(%)	n(%)	0.07788	*Mean (SD)*	*Mean (SD)*
White n(%)	3(3.1%)	12(14.0%)	11(40.7%)		0(0.0%)	26(13.8%)		8.9(3.6)	8.1(4.1)
Black n(%)	73(74.5%)	54(62.8%)	14(51.9%)		20(90.9%)	121(64.0%)		10.8(3.6)	9.3(4.4)
Puerto Rican n(%)	7(7.1%)	10(11.6%)	1(3.7%)		1(4.6%)	25(13.2%)		10.3(3.1)	9.6(5.1)
Mexican n(%)	15(15.3%)	10(11.6%)	1(3.7%)		1(4.6%)	17(9.0%)		9.6(3.5)	9.4(4.2)
								F = 0.078	F=0.5825
% of Poverty Threshhold					n(%)	n(%)	0.2092	*Mean (SD)*	*Mean (SD)*
0-99% (n=102)					14(58.3%)	91(42.7%)		10.1(4.6)	11.0(3.8)
100-299% (n=96)					9(37.5%)	90(42.3%)		8.7(4.3)	10.1(3.2)
300%+ (n=33)					1(4.2%)	32(15.0%)		8.5(4.4)	9.1(3.0)
								F=0.0637	0.0051
Education Level	n(%)	n(%)	n(%)	<0.0001	n(%)	n(%)	0.1251	mean(sd)	mean(sd)
No college(n=154)	88(83.8%)	60(60.1%)	6(18.2%)		19(79.2%)	135(63.4%)		9.4(4.4)	10.6(3.5)
At least some college (n=83)	17(16.2%)	39(39.4%)	27(81.8%)		5(20.8%)	78(36.6%)		9.1(4.7)	9.9(3.4)
								F=0.7204	F=0.1164

Table 6: Relationship between covariates: Socio-demographic characteristics, child behavior, and parental stress among urban children who experienced an asthma attack in the last year: Fragile Children and Well-Being Study, 5 year visit (N=237)

Table 6: Relationship between Socio-Demographic Characteristics, Child Behavior, and Parental Stress

	Child Behavior Checklist						Mother's Depression			Stress and Self-Efficacy	
	Aggressive	Withdrawn	Anxious	Attention	Social	Delinquent	Mother Depressed (n=38)	Mother Not Depressed (n=199)	Depressed P-value	Parental Stress Index	Low Self-Efficacy
Ethnicity	***Mean (SD)***	***Mean (SD)***	***Mean (SD)***	***Mean (SD)***	***Mean (SD)***	***Mean (SD)***	**n(%)**	**n(%)**	0.3353	*Mean (SD)*	*Mean (SD)*
White (N=26)	12.2(6.8)	2.3(2.3)	3.5(3.4)	3.6(3.8)	2.7(1.9)	3.3(1.2)	5(14.7%)	21(11.9%)		10.1(5.9)	2.4(2.6)
Black (N=141)	11.7(7.0)	2.5(2.5)	3.6(3.2)	2.7(2.9)	2.5(2.1)	3.3(1.8)	22(64.7%)	119(67.2%)		14.3(9.2)	3.4(3.6)
Mexican (N=18)	11.0(7.6)	2.5(2.9)	3.6(3.3)	2.8(3.5)	2.5(2.2)	3.3(2.5)	5(14.7%)	13(7.3%)		13.2(9.9)	2.8(2.2)
Puerto Rican (N=26)	9.1(4.6)	2.3(1.8)	4.8(3.4)	3.0(2.6)	2.0(2.1)	3.2(1.1)	2(5.9%)	24(13.6%)		15.2(9.1)	3.5(3.8)
	F=0.4190	F=0.9937	F=0.5074	F=0.5759	F=0.7724	F=0.9867				F=0.1350	F=0.5232
% of Poverty Threshhold									0.037		
0-99% (n=105)	12.5(7.3)	2.7(2.4)	4.2(3.4)	3.3(3.3)	2.9(2.1)	3.4(2.1)	n(%)	n(%)		16.4(9.4)	3.8(3.7)
100-299% (n=99)	10.5(6.2)	2.3(2.5)	3.5(3.2)	2.4(2.6)	2.0(1.8)	3.2(1.5)	24(63.2%)	81(40.7)		12.3(8.0)	2.9(3.0)
300%+ (n=33)	9.2(5.7)	2.2(2.5)	2.5(2.2)	2.3(3.0)	2.2(1.8)	3.1(1.4)	11(29.0%)	88(44.2%)		9.1(7.0)	1.9(2.8)
	F=0.0157	F=0.3178	F=0.0298	F=0.0558	F=0.0032	F=0.3876	3(7.9%)	30(15.1%)		F <0.0001	F=0.0095
Education Level									0.4949		
No college(n=154)	12.2(7.3)	2.6(2.5)	4.1(3.4)	3.2(3.3)	2.6(2.1)	3.3(1.8)	21(14.9%)	13(18.6%)		14.7(9.1)	3.6(3.6)
At least some college (n=83)	9.5(5.2)	2.2(2.4)	2.9(2.6)	2.0(2.4)	2.0(1.6)	3.3(1.5)	120(85.1%)	57(81.4%)		11.8(8.1)	2.4(2.8)
	F=0.0032	F=0.1415	F=0.0087	F=0.0023	F=0.0246	F=0.9916				F=0.0817	F=0.0056

Table 7: Odds Ratios and 95% confidence intervals of factors associated with ER/Urgent Care Use for asthma among urban children who experienced an asthma attack in the last year: Fragile Children and Well-Being Study, 5 year visit (N=237)

	Unadjusted Odds Ratio (95%CI)	Adjusted Odds Ratio (95%CI)
Psychosocial Factors: Mother		
High Parenting Stress (vs. not high)	0.97(0.56, 1.67)	---
Depression (vs. no depression)	1.13(0.56, 2.27)	---
Low Self-Efficacy (vs. not high)	0.72(0.43,1.20)	---
Low Social Support (vs. not low)	1.35(0.60,3.04)	---
Psychosocial Factors: Child		
High Total CBCL score (vs. not high)	1.08(0.64,1.83)	---
High Withdrawn Behavior (vs. not high)	2.20(1.30, 3.73)**	2.67(1.45,4.95)**
Neighborhood Social Environment & ETV		
Mother "doesn't know anyone on block well" (vs. does)	1.79(0.99,3.22)	---
Low Neighborhood Social Control (vs. not low)	2.30(1.29,4.12)**	2.61(1.34,5.04)**
Low Neighborhood Social Cohesion (vs. not low)	1.51(0.89, 2.56)	---
Exposure to Violence (ETV)		
Mother was hit/slapped/beaten (yes vs. no)	1.37(0.47, 3.98)	---
Mother witnessed a shooting (yes vs. no)	2.36(0.94, 5.92)	---
Mother witnessed someone being beaten (yes vs. no)	1.58(0.93,2.68)	---
Socio-demographic and Clinical Characteristics		
Mother's Race/Ethnicity		
White	1.00(ref)	1.0(ref)
Black	8.60(2.8,26.3)**	11.45(3.35,38.51)**
Mexican	3.44(0.91, 12.94)	4.45(1.02,19.55)*
Puerto Rican	14.30(3.24,62.97)**	13.02(2.65,63.92)**
Other Hispanic	6.05(1.54,23.73)	4.98(1.15,21.46)
American Indian / Asian	1.38(0.12,15.72)	1.45(0.12, 18.17)
Household Poverty Level		
300%+ of poverty threshold	1.00(ref)	1.00(ref)
100-199% of poverty threshold	1.84(0.83,4.09)	0.95(0.33,2.78)
0-99% of poverty threshold	1.44(0.65,3.16)	0.33(0.10,1.13)
Mother's Education		
At least some college or college graduate	1.00ref)	1.00ref)
No college coursework	2.08(1.21,3.58)**	2.23(1.10,4.52)*
Child's Health Insurance		
Private Insurance	1.00ref)	1.0(ref)
Medicaid	1.25(0.71, 2.22)	1.14(0.54,2.40)
No Insurance	0.80(0.27,2.30)	0.42(0.11,1.58)
Male Gender	1.09(0.63, 1.88)	---
Child suffers from hay fever or resp. allergies	1.72(0.61, 4.81)	---
R-square		0.28

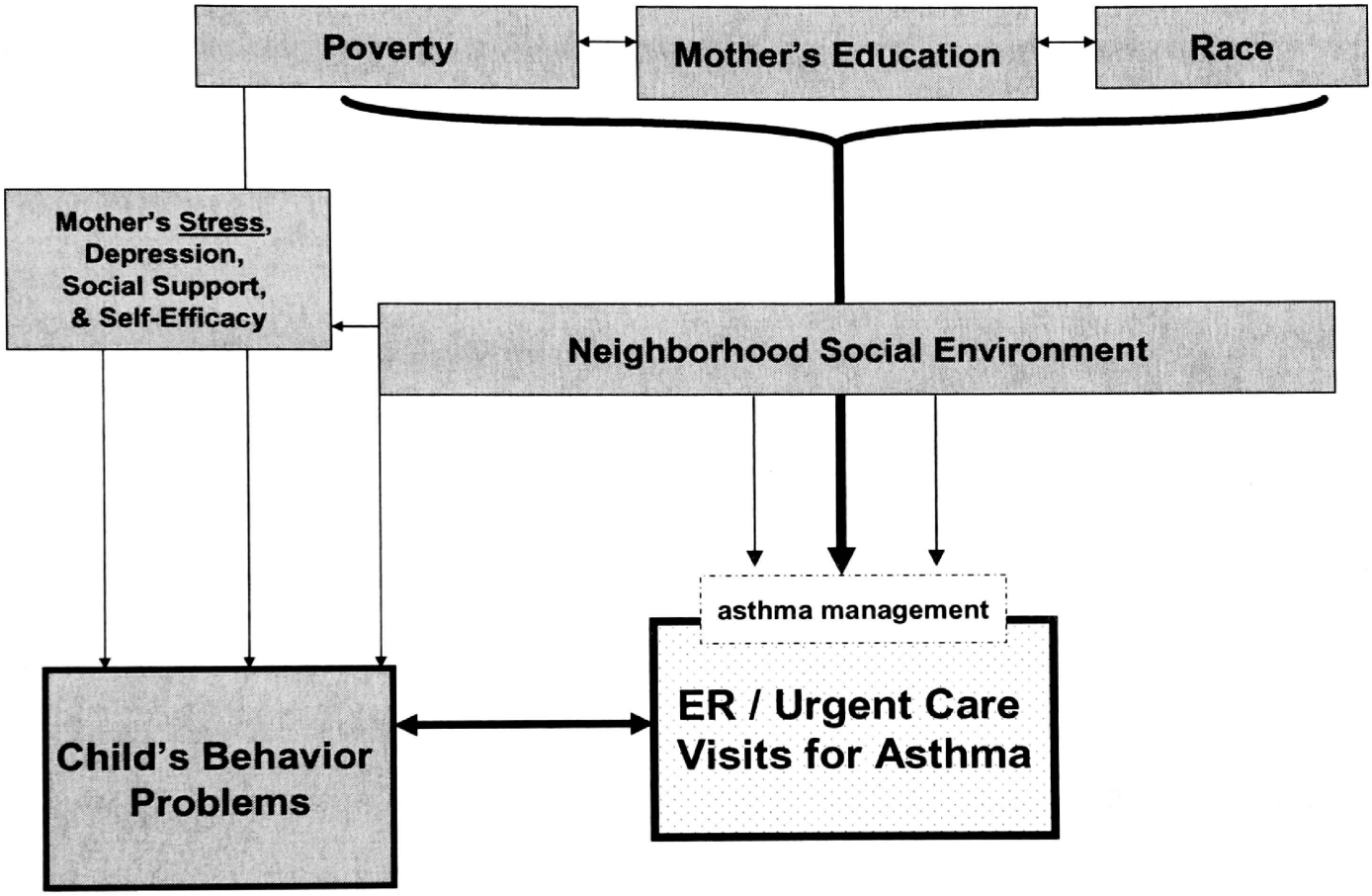
*p<0.05, **p<0.01

Table 8: Sensitivity Analysis: Odds Ratios and 95% confidence intervals of factors associated with having an asthma attack among children with a diagnosis of asthma: Fragile: Fragile Children and Well-Being Study, 5 year visit (N=610)

	Unadjusted Odds Ratio (95%CI)	Adjusted Odds Ratio (95%CI)
Psychosocial Factors: Mother		
High Parenting Stress (vs. not high)	1.32(0.92,1.89)	---
Depression (vs. no depression)	1.43(0.90,2.27)	---
Low Self-Efficacy (vs. not high)	0.85(0.61,1.18)	---
Low Social Support (vs. not low)	1.28(0.76,2.16)	---
Psychosocial Factors: Child		
High Total CBCL score (vs. not high)	1.04(0.74,1.48)	---
High Withdrawn Behavior (vs. not high)	1.18(0.84,1.64)	1.17(0.82,1.67)
Neighborhood Social Environment & ETV		
Mother "doesn't know anyone on block well" (vs. does)	1.14(0.78,1.66)	---
Low Neighborhood Social Control (vs. not low)	1.12(0.78,1.62)	1.18(0.81,1.74)
Low Neighborhood Social Cohesion (vs. not low)	0.84(0.60,1.17)	---
Exposure to Violence (ETV)		
Mother was hit/slapped/beaten (yes vs. no)	0.87(0.44,1.74)	---
Mother witnessed a shooting (yes vs. no)	1.25(0.72,2.19)	---
Mother witnessed someone being beaten (yes vs. no)	1.22(0.87,1.72)	---
Socio-demographic and Clinical Characteristics		
Mother's Race/Ethnicity		
White	1.00(ref)	1.00(ref)
Black	1.64(0.96,2.81)	1.91(1.07,3.42)
Mexican	1.07(0.53,2.18)	1.43(0.67,3.03)
Puerto Rican	1.33(0.61,2.92)	1.58(0.68,3.71)
Other Hispanic	1.32(0.62,2.82)	1.29(0.58,2.86)
American Indian / Asian	1.39(0.42,4.61)	1.59(0.45,4.58)
Household Poverty Level		
300%+ of poverty threshold	1.00(ref)	1.00(ref)
100-199% of poverty threshold	1.08(0.65,1.82)	0.96(0.51,1.79)
0-99% of poverty threshold	0.94(0.57,1.59)	0.83(0.42,1.64)
Mother's Education		
At least some college or college graduate	1.00(ref)	1.00(ref)
No college coursework	0.90(0.63,1.27)	0.88(0.58,1.35)
Child's Health Insurance		
Private Insurance	1.00(ref)	1.00(ref)
Medicaid	0.94(0.65,1.36)	0.99(0.62,1.58)
No Insurance	0.90(0.45,1.78)	0.92(0.44,1.96)
Male Gender	1.56(1.10,2.20)*	1.66(1.15,2.40)
Child suffers from hay fever or resp. allergies	2.27(1.54,3.34)**	2.45(1.63,3.67)**
R-square		0.07

*p<0.05, **p<0.01

Figure 2: Proposed conceptual model of the relationships between visiting an ER/ Urgent Care Facility for asthma, socio-demographic factors, and psychosocial stressors among urban children with asthma: Fragile Families and Child Well-Being Study, 5 year visit. (N=237)



Chapter 6: Child's Body Mass Index (BMI) and Asthma Attacks in Young Urban Children

The purpose of this study was to examine the cross-sectional relationship between a child's BMI and report of an asthma attack in the last year. As a secondary objective, we also assessed whether urban children who spent more time indoors due to neighborhood violence were more likely to experience an asthma attack in the last year, and if so, whether this relationship could be explained by their BMI.

6.I. METHODS

6.I.A. Study Sample

The Fragile Families and Child Wellbeing Study (FCF) is a longitudinal, prospective cohort of 4,898 U.S. children born in over 20 large cities since 1998 (unmarried mothers were over-sampled). Baseline data was collected at the time of the child's birth, and follow-up telephone interviews were conducted in 3 and 5 year follow-up waves. A flow chart outlining the study sample used for this analysis is shown in Figure 1. Questions regarding a mother's demographic characteristics, access to medical care, and overall health were taken from the 5 year Core Telephone Survey. Mothers were asked whether they were afraid to let their child go outside during the In-Home Longitudinal Study of Pre-School Aged Children visit and interviewers also measured children's height and weight during this visit. All interviews were conducted between 2003 and 2006. Children were eligible for inclusion in the study sample if their mothers had completed both the 5 year Core Telephone Survey and the 5 year visit of the In-Home, and had complete, non-missing information on BMI and socio-demographic measures.

6.I.B. Outcome Measure

As shown in Figure 1, the outcome variable for the primary analysis was defined as *whether or not a child had an asthma attack in the last year.* All mothers in the sample were asked whether or not their

child had been previously diagnosed with asthma. A child was designated as having had an asthma attack when a mother answered "yes" to the question, *"During the past 12 months has your child had an episode of asthma or an asthma attack?"* Of the study sample of 2,098 children with valid data for the analysis, 162 (7.7%) had experienced an asthma attack in the last year, while 1,936 (92.3%) had not.

6.I.C. Explanatory Variables

The primary explanatory variable of interest was a child's BMI status (overweight or obese). We also assessed whether urban children who stayed indoors more due to neighborhood violence were more likely to experience an asthma attack in the last year, and whether this relationship could be explained by child's BMI. Potential confounding of the association between BMI status and asthma by socio-demographic and clinical characteristics was assessed. These measures are described in detail below.

All children had their height and weight measured according to a standard protocol, during the in-home visit of the FCF LSPAC study, and Body Mass Index (BMI) was calculated as the weight in kilograms divided by the height in meters squared. Then, sex-specific BMI percentile for age was calculated using the US Centers for Disease Control and Prevention 2000 reference standards[96]. Using standardized cut-points recommended by the American Medical Association, children whose BMI was below the 85th percentile were classified as normal or underweight, those between the 85th and 94th percentiles were overweight, and those at the 95th percentile or above were considered to be obese[97]. A child was considered to have the potential to stay indoors more when a mother answered 'yes' to the question: "*Are you ever afraid to let your child go outside because of violence in your neighborhood? (Yes/No)*" during the In-Home interview. Socio-demographic measures included household income as % of federal poverty threshold (calculated), mother's self-reported race/ethnicity, mother's education level,

and child's gender. Because children who have allergies are at a higher risk for developing asthma than non-allergic children, a measure of allergic status (whether a child has had symptoms of hayfever or allergy in the last 12 months) was measured and included as a covariate in all models.

6.I.D. Statistical Analysis

We assessed the relationship of BMI category, the prevalence of asthma, being afraid to let a child go outside, and socio-demographic characteristics using Chi-Square tests and Cochran-Armitage test for trend was used to test for linear trend. The prevalence of asthma attack in the last year was then compared across explanatory variables, and Unadjusted Odds Ratio's and 95% Confidence Intervals were calculated. We used three different multivariate logistic regression models to determine how the effect of explanatory variables changed when additional variables were included in the model. In model 1, we examined whether or not BMI accounted for any of the relationship between being afraid to let a child go outside and asthma attacks by including these two variables together in the model and comparing the Odds Ratio's to those calculated in the crude analysis. In model 2, mother's race was added to the model, and in model 3, we assessed the relationship between BMI and asthma attacks after adjustment for all potential confounders (mother's race poverty, mother's education level, smoking, child's gender, and hayfever/respiratory allergies). Because previous studies have shown that the relationship between BMI and asthma differs by gender and race[98, 99], we also tested two-way interactions between BMI category and gender, BMI category and race, and the 3-way interaction between BMI category, race, and gender. Goodness of fit for multivariate models was compared using AIC and R-squared values. All analyses were performed using SAS version 9.1.

6.II. RESULTS

6.II.A. Description of the Study Sample

The study sample consisted of 2,098 children who were participants in both the 5-year FCF telephone survey and the 5 year In-Home visit with valid, non-missing values on BMI measurements and socio-demographic characteristics. Of these 2,098 children, 162(7.7%) had experienced an asthma attack in the last year, and 1,936 (92.3%) had not, 364(17.3%) were classified as obese, 368(17.5%) were classified as overweight, and 1,366 (65.1%) were classified as normal or underweight. Three hundred and sixty two mothers (17.3%) reported that they were afraid to let their child go outside because of violence in the neighborhood. In the study sample, 424(20.2%) of mothers reported their race as white, 1098(52.3%) reported their race as black, and 74(3.5%) reported their race as Puerto Rican, 826(39.4%) mothers had not graduated from high school, 561(26.7%) had completed high school or a GED, 518(24.7%) had completed some college or technical school, and 193(9.2%) were college graduates. The median household income for children included in the study sample was $18,000 (IQR $0, $40,000). Of the children included in the sample, 1082(51.6%) were males and 59 (2.8%) had experienced symptoms of hayfever or respiratory allergies over the last year.

6.II.B. Bivariate and Multivariate Analysis

Table 1 shows characteristics of the study sample by child's BMI. A child's BMI was associated with a report of an asthma attack in the last year and with mother's race/ethnicity. 12.6% of children who were classified as obese had experienced an asthma attack in the last year, compared to 7.1% of overweight children and 6.6% of normal/underweight children (p=0.0004). 20.1% of children who were classified as obese had mothers who reported that they were afraid to let their child go outside because of violence, compared to 19.8% of overweight and 15.8% of normal/underweight children (p=0.0576). Though

relationships between child's BMI and other variables did not reach statistical significance, a higher percentage of children in the obese category were girls, had mothers who had not completed a high school degree, and had at least one smoker in the household.

Odds Ratios and 95% Confidence Intervals of the association between child's BMI, staying indoors due to violence, and socio-demographic characteristics and asthma attacks are shown in Table 2. In unadjusted analyses, obese children were more likely to have experienced an asthma attack in the last year compared to those who were in the normal/underweight category (Unadj. OR = 2.1, 95% CI: 1.4, 3.0). Also, children whose mothers reported that they were afraid to let their children go outside because of violence in the neighborhood were more likely to have experienced an asthma attack in the last year (Unadj. OR = 1.8, 95% CI: 1.2, 2.6). In model 1, we examined whether or not BMI accounted for any of the relationship between being afraid to let a child go outside and asthma attacks by including these two variables together in the model and comparing the Odds Ratios to those calculated in the crude analysis. We found that after adjusting for child's BMI, the relationship changed very little (Adj. OR = 1.7, 95% CI: 1.2, 2.5 (Table 2, Model 1).

Multivariate adjustment for socio-demographic covariates (mother's race, poverty level, education, smoking, and child's allergies) had very little impact on the relationship between obesity and experiencing an asthma attack. After adjustment for race, obese children remained more likely to have experienced an asthma attack in the last year compared to those who were in the normal/underweight category (Adj. OR = 1.9, 95% CI: 1.3, 2.8) (Table 2, Model 2). Further adjustment for poverty level, mother's education, smoking, and allergies had almost no impact on the effect estimates (Adj. OR = 1.9, 95% CI: 1.3, 2.8) (Table 3, Model 2). We found no evidence of interaction in our sample. The

interactions assessed between BMI category, race, and gender were not significant ($p>0.15$ for all interaction terms). Models were stratified by mother's race (Table 3) and child's gender (Table 4) to examine the extent to which effect estimates differed by race and gender Effect estimates were nearly identical by gender. However, effect estimates differed substantially by race (black vs. white), indicating that the association between BMI and obesity was strongest among black children.

6.III. Discussion

This study showed a strong association between obesity and experiencing an asthma attack among young urban children. Children who were obese were nearly twice as likely to have had an asthma attack in the last year, even after adjustment for socio-demographic characteristics. While this relationship has been shown among adults[72, 100] and older children and adolescents[98, 101], there has been less investigation as to whether a link between BMI and asthma also persists among young (<6 years) children, particularly those living in urban environs[99].

As a secondary objective, we also assessed whether urban children who stayed indoors more due to neighborhood violence were more likely to experience an asthma attack in the last year, and whether this relationship could be explained by the fact that these children also have higher BMI levels. The prevalence of overweight and obesity was higher among children of mothers with fear of letting their children go outside (20.2% vs. 17.0%, and 20.2% vs. 16.8% , respectively). Additionally, children of mothers with fear of letting their children go outside had increased odds of having an asthma attack, even after adjustment of socio-demographic variables. However, when BMI percentile was added to a model containing only fear of letting a child go outside (Model 1), we saw no change in the effect estimate, indicating the relationship between fear of letting a child go outside and asthma is not because of increased BMI. Instead, fear of letting a child go outside may be associated with asthma attacks

through alternative pathways such as exposure to violence and the neighborhood social environment, or increased exposure to indoor allergens.

In our sample of 5 year old urban children, only those with BMI values that were at or above the 95th percentile (obese) had increased odds of having an asthma attack. We did not detect a significant association between being *overweight* and having an asthma attack in the last year. Other studies have found that children in both the overweight and obese categories have increased risk of asthma. In a community based sample of 853 2-11 year old children screened for the Harlem Children's Zone Asthma Initiative, overweight boys and girls had a 2-fold risk of asthma compared to children of normal weight[98]. More information is needed to determine how extreme a child's BMI value must be in order to increase the odds of having an asthma attack.

In our sample, we did not see evidence that gender modified the relationship between BMI and asthma. This is somewhat surprising given that previous studies have shown gender can act to modify the BMI – asthma associations. When analyses of data from the Harlem Children's Zone Asthma initiatives, were stratified by gender, 6-11 year old girls who were overweight had increased risk of asthma diagnosis, but not younger girls or boys[98]. In the Tucson Children's Respiratory Study, 11 year old girls, but not boys, who had BMI's greater than or equal to the 85th percentile were more likely to experience wheezing symptoms[102]. In a study of 9,357 children from rural regions in Bavaria, a strong association was seen between overweight/obesity and doctors' diagnosed asthma in 5 and 6 year old girls[99]. While the interaction between race and BMI category was not significant ($p \leq 0.15$), stratified analyses did show evidence that the association between BMI category and asthma attacks was stronger in children of mothers who reported their race as black compared to children of mothers who reported their race as

white. Further examination of the reasons for differences in effect estimates, by mother's race, is warranted.

Data from our sample showed no relationship between a child's BMI percentile and a report of hayfever or respiratory allergies in the last year. This finding is consistent with previous studies which have shown no relationship between overweight/obesity and crude measures such as descriptions of atopic conditions, allergen-specific positive skin prick tests, and IgE[99, 103-105]. However, recent evidence from the 2005-2006 National Health and Nutrition Examination Survey shows that when atopy was assessed using total serum IgE, mean IgE levels were higher among obese and overweight children compared to those of normal weight. This suggests that obesity may, in fact, contribute to the prevalence of allergic disease in children[106]. Further research is needed on the role of obesity related systemic inflammation in the development of allergic disease and asthma.

The results of this study should be interpreted with several limitations in mind. First, because the study was conducted among urban children and unmarried mothers were over-sampled, the rates of asthma attacks are not necessarily representative of the general population. The outcome variable was based on mother's recall over the last year, and we had no ability to confirm with medical records. Also, in our assessment of whether urban children who stayed indoors more due to neighborhood violence were more likely to experience an asthma attack in the last year, we had to use mother's fear of letting their child outdoors as a proxy for whether or not a child actually spent increased time indoors and had reduced physical activity. More detailed measures on actual time spent indoors, as well as the time spent in specific activities such as watching television or engaging in exercises would have strengthened the analysis.

The cross-sectional nature of the study makes it difficult to determine the direction of the relationship between BMI and asthma. It is possible that children with asthma may be restricted from participating in physical activities and therefore become overweight. Alternatively, obesity may lead to increased bronchial reactivity. Future studies which clarify the direction of this association are needed to impact clinical care. If obesity is a risk factor for the development of asthma, then clinicians should closely monitor obese youth for the development of asthma. Conversely, if asthma leads to the development of obesity in urban children, then careful attention should be given to specialized dietary and activity programs for children with asthma.

6.IV. Conclusion

In summary, our study identified an association between obesity and report of an asthma attack among young children living in urban areas. Adjustment for race, education, poverty, respiratory allergies, and gender did not impact this finding. We also found that children of mothers who feared letting their child play outside due to neighborhood violence had higher prevalence of overweight and obesity and had increased odds of an asthma attack. However, high BMI did not appear to be the mechanism by which staying indoors is related to asthma. Further longitudinal analysis is needed to determine the direction of the relationship between BMI, lack of physical activity/staying indoors due to violence, and asthma among young, urban children.

Figure 1: Flowchart Outlining Datasets Combined to Create Study Sample (manuscript 3)

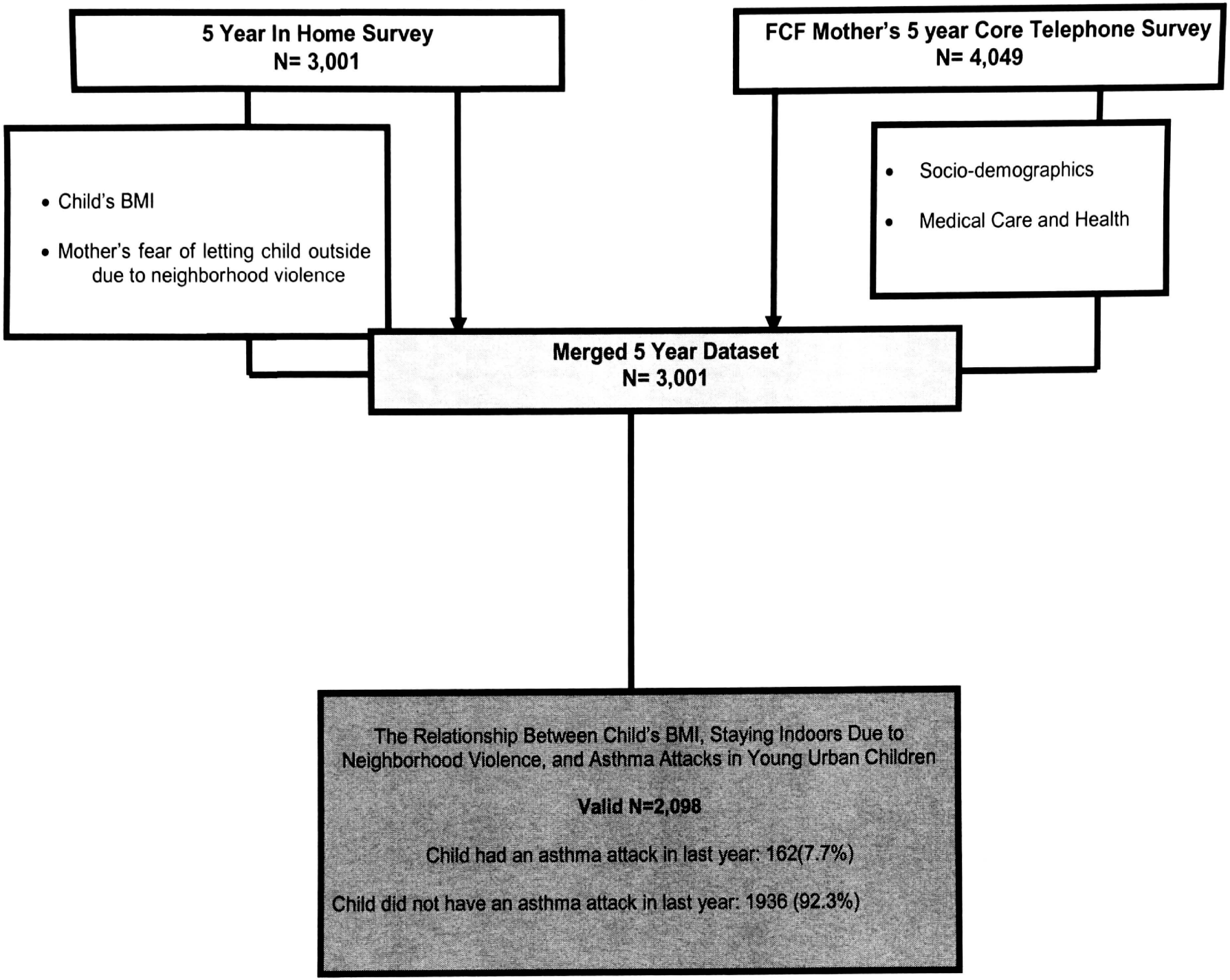


Table 1: Characteristics of the Study Sample by Child's BMI (5 year FCF Visit) N=2,098

	Child's BMI normal/underweight n=1,366	Child's BMI overweight n=368	Child's BMI obese n=364	P
Child's Asthma				
Asthma attack in the last year	90(6.6%)	26(7.1%)	46(12.6%)	0.0004
No asthma attack in the last year	1276(93.4%)	342(92.9%)	318(87.4%)	
Mother afraid to let child go outside b/c of violence				
No	1150(84.2%)	295(80.2%)	291(80.0%)	0.0576
Yes	216(15.8%)	73(19.8%)	73(20.1%)	
Demographic and Clinical Characteristics				
Mother's Race/Ethnicity				0.0005
Non-Hispanic White	288(21.1%)	80(21.7%)	56(15.4%)	
Non-Hispanic Black	736(53.9%)	182(49.5%)	180(49.5%)	
Mexican	160(11.7%)	62(16.9%)	59(16.2%)	
Puerto Rican	45(3.3%)	11(3.0%)	18(5.0%)	
Other Hispanic	92(6.7%)	25(6.8%)	44(12.1%)	
American Indian / Asian	45(3.3%)	8(2.2%)	7(1.9%)	
HH Income: % of Federal Poverty Level				
300+%	238(17.4%)	64(17.4%)	56(15.4%)	0.3779
100-299%	498(36.5%)	147(40.0%)	159(43.7%)	
0-99%	630(46.1%)	157(42.7%)	149(40.9%)	
Mother's Education Level				
College graduate or grad school	134(9.8%)	33(9.0%)	26(7.1%)	0.2512
Some college or technical school	339(24.8%)	88(23.9%)	91(25.0%)	
High School grad or GED	357(26.1%)	107(29.1%)	97(26.7%)	
<Hs graduate	536(29.2%)	140(38.0%)	150(41.2%)	
Smoking				
No smokers in household	798(58.4%)	226(61.4%)	205(56.3%)	0.3681
1 or more smokers in household	568(41.6%)	142(38.6)	159(43.7%)	
Child's Gender				
Female	653(47.8%)	175(47.6%)	188(51.7%)	0.3991
Male	713(52.2%)	193(52.5%)	176(48.4%)	
Child's Allergies				0.4172
No hayfever/resp. allergies	1331(97.4%)	358(97.3%)	350(96.2%)	
Hayfever/respiratory allergies	35(2.6%)	10(2.7%)	14(3.9%)	

p-value for Chi-square test of association

Table 2: Child's BMI, Mother's Fear of Letting Child Go Outside, and Socio-Demographic Characteristics Associated with Asthma Attack by Age 5 (N=2,098)

	% With Asthma Attack	Unadj. Odds Ratio (95%CI)	Model 1 Adj. OR (95%CI)	Model 2 Adj. OR (95%CI)	Model 3 Adj. OR (95%CI)
Child's BMI percentile					
<85th percentile (normal/underweight)	6.6%	1.00(ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
85th to <95th percentile (overweight)	7.1%	1.01(0.69,1.69)	1.05(0.67,1.66)	1.07(0.68,1.70)	1.07(0.68,1.70)
≥95th percentile (obese)	12.6%	2.05(1.41,2.99)**	2.00(1.37,2.92)**	1.94(1.32,2.83)**	1.89(1.28,2.80)**
Mother afraid to let child go outside b/c of neighborhood violence					
No	6.9%	1.00(ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Yes	11.6%	1.77(1.22,2.56)**	1.73(1.19,2.51)**	1.56(1.07,2.29)*	1.65(1.11,2.44)*
Socio-Demographic Characteristics					
Mother's Race/Ethnicity					
Non-Hispanic White	3.8%	1.00(ref)	---	1.00 (ref)	1.00 (ref)
Non-Hispanic Black	8.8%	2.47(1.44,4.25)**	---	2.22(1.28,2.85)**	2.31(1.29,4.14)**
Puerto Rican	14.9%	4.45(1.98,10.03)**	---	3.99(1.76,9.04)**	4.62(1.96,10.89)**
Mexican	6.4%	1.75(0.87,3.48)			1.68(0.81,3.51)
Other Hispanic	10.6%	3.01(1.48,6.11)*			2.88(1.37,6.04)*
American Indian/Asian	5.0%	1.34(0.38,4.75)			1.32(0.37,4.75)
HH Income: % of Federal Poverty Level					
300+%	6.2%	1.00(ref)			1.00(ref)
100-299%	8.1%	1.34(0.81,2.22)	---	---	1.11(0.64,1.93)
0-99%	8.0%	1.33(0.81,2.18)	---	---	1.07(0.60,1.92)
Mother's Education Level			---	---	
College graduate or grad school	4.2%	1.00(ref)			1.00(ref)
Some college or technical school	9.9%	2.53(1.18,5.42)	---	---	1.67(0.73,3.83)
High School grad or GED	6.8%	1.68(0.77,3.67)	---	---	0.96(0.40,2.33)
<Hs graduate	7.9%	1.98(0.93,4.19)	---	---	1.03(0.43,2.48)
Smoking					
No smokers in household	7.2%	1.00(ref)	---	---	1.00(ref)
1 or more smokers in household	8.5%	1.21(0.88,1.67)	---	---	1.21(0.86,1.72)
Child's Gender					
Female	5.5%	1.00(ref)	---	---	1.00(ref)
Male	9.8%	1.86(1.33,2.61)	---	---	2.02(1.43,2.85)**
Child's Allergies					
No hayfever/resp. allergies	7.3%	1.00(ref)	---	---	1.00(ref)
Hayfever/respiratory allergies	23.7%	3.98(2.13,7.41)	---	---	5.13(2.16,7.92)**
R-square			0.0236	0.0416	0.0845
AIC			1128.06	1122.07	1099.24

*p<0.05 **p<0.01

Table 3: Association between and BMI category and Asthma Attack by Age 5, stratified by Mother's Race (black/white)

	% With Asthma Attack	Unadj. Odds Ratio (95%CI)	Adj. OR (95%CI)
Blacks Only (N=1098)			
Child's BMI percentile			
<85th percentile (normal/underweight)	7.6%	1.00(ref)	1.00 (ref)
85th to <95th percentile (overweight)	8.2%	1.09(0.60,1.98)	1.00(0.54,1.84)
≥95th percentile (obese)	14.4%	2.05(1.25,3.37)	2.11(1.25,3.54)**
Whites Only (N=424)			
Child's BMI percentile			
<85th percentile (normal/underweight)	3.5%	1.00(ref)	1.00 (ref)
85th to <95th percentile (overweight)	3.8%	1.08(0.29,4.03)	1.09(0.28,4.20)
≥95th percentile (obese)	5.4%	1.57(0.41,5.91)	1.58(0.40,6.18)

*Odds Ratio's adjusted for being afraid to let child go outside due to neighborhood violence, mother's education level, smoking present in the household, child's gender, and allergies.

Table 4: Association between and BMI category and Asthma Attack by Age 5, stratified by Child's Gender

	% With Asthma Attack	Unadj. Odds Ratio (95%CI)	Adj. OR (95%CI)
Females Only (N=1016)			
Child's BMI percentile			
<85th percentile (normal/underweight)	8.6%	1.00(ref)	1.00 (ref)
85th to <95th percentile (overweight)	7.3%	1.58(0.79,3.17)	1.83(0.89,3.75)
≥95th percentile (obese)	17.6%	1.87(0.98,3.56)	2.01(1.02,3.95)
Males Only(N=1082)			
Child's BMI percentile			
<85th percentile (normal/underweight)	4.4%	1.00(ref)	1.00 (ref)
85th to <95th percentile (overweight)	6.9%	0.84(0.46)	0.81(0.43,1.50)
≥95th percentile (obese)	8.0%	2.29(1.43,3.65)	2.01(1.22,3.29)

*Odds Ratio's adjusted for being afraid to let child go outside due to neighborhood violence, mother's race, mother's education level, smoking present in the household, and allergies.

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