Racial and Ethnic Disparities in Pediatric Asthma in Metropolitan America, 2011: Assessing the Roles of Residential Inequality and Segregation

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Abstract

Among children aged 1 to 9, asthma is the leading cause of hospitalization in the United States. Many studies find that asthma has a higher than average prevalence among poor, minority, and inner-city residents. However, little research has explored how racial and ethnic disparities in housing quality and residential characteristcs, overall and by segregation levels, have contributed to racial and ethnic disparities in asthma. This paper builds upon this limited literature by using new data from the 2011 American Housing Survey (AHS). These data are the first panel of the AHS, which is a rich source of data on residential characteristics, to ask health questions of households. Our analyses of these data find that racial and ethnic disparities in the prevalence of pediatric asthma remain, even after accounting for racial and ethnic differences in housing conditions, and other residential, demographic, and socioeconomic characteristics. Moreover, we find that black-white disparities in asthma appear to be explained more by disparities in housing and other residential characteristics in more highly segregated metropolitan areas than in moderately and lower segregated areas.

Introduction

Asthma is increasing every year, and among children aged 1-9, it is the leading cause of hospitalization in the United States (CDC 2011; U.S. Department of Health and Human Services 2011). It is the most common chronic illness among children in the United States (Pearlman 2006); the Centers for Disease Control and Prevention reported that in 2011, about 1 in 10 children (9.5%) had asthma (CDC 2011) and the prevalence is particularly high among minority groups, such as blacks Puerto Ricans, and Dominicans (Mendoza et al. 1991; Hunninghake et al., 2006; Akinbami et al., 2009). Using data from the 1998-2008 National Health Interview Survey (NHIS), Mehta et al. (2013) find that black children's rate of asthma was 1.5 times that of whites (17.54% versus 11.66%), although the rates for Hispanic and Asian children were the same and lower, respectively, relative to whites. Many studies have also found that asthma has a higher than average prevalence among poor and inner-city residents (Williams et al., 2009; Canino et al., 2009).

Housing and neighborhood conditions have been linked to the prevalence of asthma. Substandard housing conditions – including the presence of dust mites, feces from cockroaches and mice, as well as mold – have all been shown to trigger asthma (Bashir 2002; Kreiger and Higgins 2002; Northridge et al. 2010; Rauh, Chew, and Garfinkel 2002; Vesper et al. 2013). The neighborhoods in which people reside have also been suggested to influence asthma although the precise mechanisms by which this occurs are not always clear. Katz and colleagues (2001) found a 50 percent drop in asthma attacks among children in the Moving to Opportunity Program (MTO) in Boston when they moved from public housing in high-poverty areas to better quality housing in less poor neighborhoods. The levels of collective efficacy in the neighborhoods and the trust that parents place with neighbors to keep their children safe have also been found to impact the prevalence of asthma, with more collective efficacy and trust being associated with lower levels of asthma (Cagney and Browning 2004; Camacho-Rivera et al. 2014).

Interestingly, studies that examine the roles that housing and neighborhood conditions play in affecting asthma pay little explicit attention to how such factors mediate the racial and ethnic disparities that exist in asthma (except see Rosenbaum (2008)). This is surprising given that significant racial and ethnic disparities exist in housing and neighborhood conditions (Friedman et al. 2014; Friedman and Rosenbuam 2004, 2007; Rosenbaum and Friedman 2007). Most of the studies that specifically focus on racial and ethnic disparities in asthma find that differences in socioeconomic status between minorities and whites explain part but not all of these racial and ethnic inequalities in asthma (Gold and Wright 2004). For the most part, data on health outcomes, and housing and neighborhood conditions have been hard to obtain in one dataset. Rosenbaum (2008) had access to such data via the 2002 New York City Housing and Vacancy Survey. She finds that racial and ethnic inequality in residential characteristics affect racial and ethnic disparities in the prevalence of asthma, but they do not fully eliminate them. Rosenbaum's study is limited, however, because it is focused only on households residing in New York City and the data used in the study are more than a decade old. Another main limitation of Rosenbaum's study is that it ignores the role of residential segregation in affecting asthma. She controls for the percent white in the larger neighborhood where households reside, but because the study examines only one city, it is difficult to ascertain the effect of segregation on asthma more directly.

Ironically, although segregation is touted to be important in impacting asthma (Boardman et al. 2001; Williams at al. 2009) as well as individual health more generally (Acevedo-Garcia et al. 2003; Osypuk and Acevedo-Garcia 2010), no research, to our knowledge, has examined its direct impact on asthma, overall, or on pediatric asthma. In a systematic review of social science and health literature conducted in 2008, Kramer and Hogue (2009) identified only 39 studies that explicitly examined the link between segregation and health outcomes. However, none of these studies examined asthma as an outcome. In a more recent review of the same literature, focusing on studies published between January 2003 and March 2014, Yang (2014) identified 33 articles that utilized multilevel modeling

procedures to examine the impact of residential segregation on health outcomes. However, none of them explored asthma or pediatric asthma.

Using data from the 2011 American Housing Survey (AHS), this study seeks to explain racial and ethnic disparities in asthma among households with children by explicitly considering the roles of racial and ethnic residential inequality and residential segregation. The AHS data are uniquely suited for this paper because they contain nationally representative data on housing units and households in such units in the United States as well as in 29 metropolitan-specific samples. Most relevant to the current paper is the fact that the 2011 national and metropolitan-level AHS data contain information on the presence of asthma among children in households. In addition, the 2011 data contain information on the housing quality of the unit (e.g., the presence of cockroaches and rodents), socioeconomic, demographic, and other health measures of households (e.g., whether anyone smoked in the unit).

Using data from the national and metropolitan samples of the 2011 panel of the American Housing Survey (AHS), our paper seeks to fulfill four main objectives: (1) document the racial and ethnic disparities in the prevalence of pediatric asthma; (2) characterize the nature of racial and ethnic differences in housing conditions, and other residential, demographic, and socioeconomic characteristics of households that might contribute to the racial and ethnic disparities that exist in pediatric asthma; (3) examine the extent to which racial and ethnic disparities in the pediatric prevalence of asthma are reduced with controls for the housing conditions and other residential, demographic, and socioeconomic characteristics of households; and (4) examine whether the housing conditions and other residential characteristics of households mediate the racial and ethnic disparities in asthma more in highly segregated metropolitan areas than in moderately and less segregated metropolitan areas.

Residential Inequality and Racial and Ethnic Disparities in Asthma

Racial and ethnic residential inequality is a well-known problem in modern-day America and has received much attention in the urban sociological literature. For example, in metropolitan America, blacks and Hispanics have been shown to more likely than whites to occupy poorer-quality housing – housing that has at least one of the following problems: water leaks, heating or toilet breakdowns, the presence of rodents, cracks/holes in the walls or ceiling, or large patches of peeling paint or plaster -- controlling for relevant socioeconomic factors (Friedman and Rosenbaum 2004). Such disparities exist even among homeowners who have invested more in acquiring their homes than renters (Friedman and Rosenbaum 2004). Black and Hispanic owners are 1.66 and 2.00 times as likely as white owners, respectively, to live in inadequate housing in metropolitan America, controlling for relevant socioeconomic and demographic characteristics. Among owners, these racial and ethnic disparities in housing quality are reflected in the lower housing values and appreciation in housing values of minorities relative to whites (Flippen 2001, 2004; Friedman et al. 2014).

The neighborhoods in which minorities reside are significantly inferior in quality to those where whites live, even after accounting for differences in socioeconomic status and demographic factors. Among middle-class and affluent homeowners in metropolitan America, Friedman and colleagues (2014) find that blacks and Hispanics are more likely than their white counterparts to reside in neighborhoods with significantly greater shares of abandoned buildings and buildings with barred windows; a lack of open, green spaces; significantly more neighborhood problems; and that are less likely to be located in suburbs. Black middle-class households often live in neighborhoods with as much crime and violence as their lower-class and poor counterparts (Pattilo-McCoy 1999). Households with children are not shielded from such environments. Rosenbaum and Friedman (2001) find that in New York City, black and Hispanic households with children are significantly more likely than white households with children to live in neighborhoods with higher juvenile detention rates, teenage fertility rates, and levels of welfare receipt and poorer math achievement levels.

How do such disparities in residential attainment translate into disparate rates of pediatric asthma between minorities and whites? There are direct and indirect mechanisms linking these inequalities together (Gold and Wright 2005; Rosenbaum 2008). The disparate exposure that minorities have to substandard housing problems that trigger asthma, relative to whites, is probably the most direct mechanism. As mentioned earlier, housing conditions such as dampness and feces from rodents and cockroaches are directly linked to the prevalence of asthma (Bashir 2002; Kreiger and Higgins 2002; Northridge et al. 2010; Rauh, Chew, and Garfinkel 2002; Vesper et al. 2013). The fact that minorities, and blacks in particular, are more likely than whites to reside in homes with such substandard housing conditions explains part of the reason why minorities have higher rates of asthma than whites (Rosenbaum 2008), although more research needs to be done to explore this linkage because it has been limited in geographic scope and the direct linkage does not explain all of the racial and ethnic disparities in asthma prevalence.

Another direct mechanism that could potentially mediate the relationship between race and ethnicity and asthma is the greater exposure of minorities to air pollution, relative to whites. Past research has shown that air pollution and heavy traffic are associated with asthma (Clougherty et al., 2007; Ryan et al., 2007; Salam et al. 2008; Schwartz 2004). The concentration of air pollution, as gauged by outdoor nitrogen dioxide (NO_2), is 38% higher for nonwhites as compared to whites in the contiguous United States (Clark et al. 2014). However, no research to our knowledge explicitly links racial and ethnic disparities in asthma to the greater exposure of minorities to pollution. In large part this relates to the fact that good data on pollution are hard to obtain and particularly in conjunction with data on asthma.

There are other, more indirect mechanisms linking racial and ethnic inequality in residential attainment to disparities in asthma. Prominent among them is stress (Gold and Wright 2005). As noted above, minorities tend to live in neighborhoods with more social disorder and crime than whites. The fear and stress caused by living in such environments can raise the prevalence of asthma,

particularly among children (Camacho-Rivera et al. 2014). Coupled with the indoor and outdoor pollutants, this negative environmental context can make individuals more susceptible to illness by causing an increase in their allostatic load and eroding the effectiveness of their immune system (Gold and Wright 2005; Massey 2004). With respect to asthma, the lowered immune system has been shown to cause more respiratory infections in children, which in turn has been linked to subsequent asthma (Boyce et al. 1995; Sandburg et al. 2000; Wright et al. 2004). Stress brought about by residing in disadvantaged neighborhoods can also cause individuals to spend more time in their homes more and be more exposed to the harmful triggers of asthma in the home discussed earlier (Cagney and Browning 2004; Gold and Wright 2005). Stress may also relate to asthma by causing parents to engage in more unhealthy behaviors like smoking, which raises the prevalence of having asthma (Strachan and Cook 1997, 1998; Massey 2004).

Residential Segregation and Asthma

Racial and ethnic residential segregation is a prominent feature in metropolitan America, even more than 45 years after the passage of the Fair Housing Act. Although in recent years, there have been declines in such segregation, particularly between white and blacks, segregation remains in the "high" range in many of the largest metropolitan areas (Logan and Stults 2011; Massey and Denton 1993). For example in the New York and Los Angeles metropolitan areas in 2010, the two largest metropolitan areas in the U.S., 79.1% and 65% of blacks and 63.1% and 63.4% of Hispanics would have had to move, respectively, to be evenly distributed with whites (Logan and Stults 2011).

Historically, the forces that generated residential segregation have also contributed to the concentration of minorities in poorer-quality housing, but it is particularly the case for blacks, given the longstanding color line that has existed in the U.S. between whites and blacks (Massey and Denton 1993). Thus, while we intend to focus our overall analysis of racial and ethnic disparities in asthma as they relate to racial and ethnic residential inequality on whites and non-white minorities (per the

discussion above), our analyses that document the role of residential segregation on asthma will focus explicitly on the white-black disparity in pediatric asthma.

Two major forces caused the rise of ghettos and contemporary residential segregation -- the industrialization period of the late 19th and early 20th centuries and the Great Migration of blacks from the South to the North (Massey and Denton 1993: 26). White negative racial attitudes toward blacks increased during this period, and the rise of racial violence contributed greatly to the formation of ghettos, particularly in Northern and Midwestern cities that experienced both of these phenomena. During this period, the housing choices of blacks, even among those who were affluent, became significantly constrained to the ghettos where housing was extremely inadequate or dilapidated and neighborhoods were very crowded (Massey and Denton 1993: 33).

In these cities, the existence of ghettos and in turn the constrained housing choices of blacks were maintained by several key factors, often operating in conjunction with one another. The discriminatory underwriting practices began by the Home Owners Loan Corporation (HOLC) in 1933 and subsequently adopted by the Federal Housing Administration (FHA), from 1934 to 1968, led to the redlining practices that starved inner-city neighborhoods of capital and, coupled with the establishment of the Veterans Administration, under the GI Bill after World War II, hastened the mass exodus of whites to the suburbs (Jackson 1985). The FHA provided very limited funds towards the reconstruction of existing housing stock or construction of multifamily homes and instead devoted the large majority of its financing to new housing in suburbs. At the same time, white residents formed neighborhood associations and implemented restrictive covenants, which preserved the racial homogeneity of their neighborhoods so that blacks could not settle there (Massey and Denton 1993: 36). Real estate agents adopted practices of blockbusting and racial steering, which also strengthened the color line between whites and blacks and perpetuated residential segregation (Massey and Denton 1993). Taken together, these historical forces effectively kept blacks out of neighborhoods with better quality housing and better amenities (e.g., good schools, access to jobs, better quality healthcare).

There is no doubt that contemporary black access to better quality housing and neighborhoods has been shaped by these historical forces, particularly in areas that grew and formed during this earlier period of intense racial discrimination in housing (e.g., New York, Chicago, Philadelphia, Milwaukee, Cleveland). As reviewed in the previous section, racial and ethnic inequality in residential attainment persists well into the 21st century, reflecting historical and contemporary segregating forces. Indeed, housing discrimination continues to shape the housing choices of blacks today. Results from the 2012 Housing Discrimination Study (HDS) revealed that black home seekers in the rental and sales markets were told about 11.4% and 17% fewer homes, respectively, and shown 4.2% and 17.7% fewer homes, respectively, than their white counterparts (Turner et al. 2013).

However, there are many metropolitan large areas that have lower contemporary rates of residential segregation between whites and blacks such as Dallas, Charlotte, Phoenix, and San Diego. There are several reasons for the differences in segregation, which directly impact the nature of the housing in which blacks have settled. In these metropolitan areas, a greater share of housing stock was built after 1969, when discrimination in the housing market became illegal (Farley and Frey 1994). Thus, the housing choices of blacks are more open and likely of much better quality than in areas with much older housing stock. Relatedly, the age of the main city within these metropolitan areas is much younger than those in more segregated areas, and as such, the ecological structure of these newer metropolitan areas is less conducive to residential segregation because it is not typically comprised of a densely populated core surrounded by suburbs (Farley and Frey 1994; Massey and Denton 1987). The fact that the ecology is different in these newer areas is also likely to reduce the racial and ethnic disparities found in housing conditions.

A final important factor that is likely to have played a role in keeping segregation low in such metropolitan areas and to have reduced residential inequality between whites and blacks are the differences in the political structures between newer and older areas that have guided schooling, policing, and other local policy-related decisions (Farley and Frey 1994). Because of school

desegregation that took place in the South, many school districts have operated at the county level and do not have separate school districts by local jurisdiction, as is the case in many suburbs of Northern and Midwestern cities. In addition, through the process of annexation, cities grew quite large in the South and West, by incorporated areas that might have been suburbs in the North and Midwest. Such a growth process allowed these newer areas to raise considerable tax revenue. What resulted from this process were lower levels of residential segregation.

Hypotheses

Our study focuses on fulfilling four objectives, which were posed in the introduction. Two are descriptive in nature and two are more analytical. The preceding review of the literature suggests the following hypotheses in relation to the latter two objectives.

1) We will examine the extent to which racial and ethnic disparities in the pediatric prevalence of asthma are reduced with controls for the housing conditions and other residential, demographic, and socioeconomic characteristics of households. In general, given the past research that has been done focused on the linkages among race and ethnicity, housing conditions, and asthma, we expect that the housing conditions will be significant in influencing pediatric asthma and will explain an important share of the racial and ethnic disparities in pediatric asthma, controlling for other relevant characteristics.

2) We will evaluate whether the housing and other residential characteristics of households mediate the racial and ethnic disparities in asthma – specifically between blacks and whites -- more in highly segregated metropolitan areas than in moderately and less segregated metropolitan areas. We expect that housing conditions will be significantly related to pediatric asthma in both contexts. However, given the extensive differences in the way that highly segregated metropolitan areas formed historically, compared to moderately and less segregated areas, we expect that the share of the black-white disparity in pediatric asthma that will be explained by black-white residential inequality in

housing conditions as well as in characteristics gauging the ecological structure of households (i.e., central city location, housing tenure) will be greater in more segregated areas as compared to moderately and less segregated areas.

Data and Methods

Our analyses of racial and ethnic disparities in pediatric asthma are based on data from the 2011 panel of the American Housing Survey (AHS), a multistage probability sample of about 60,000 housing units across the U.S. that, for the first time in the survey's history, were combined with nearly 120,000 units from the 29 AHS metropolitan samples, making the total sample size over 180,000 housing units. We take advantage of data from the 2011 AHS because for the first time in decades, the survey included a "healthy homes" topical module. Households were asked to report on various questions concerning their health including whether and how many children in the home have ever been told by a health professional that they have asthma. Because the AHS contains many questions on housing quality and residential circumstances, the addition of the asthma questions make the data ideal for our study. Indeed, no other national-level dataset, to our knowledge facilitates the ability to study these phenomena together. In addition, because of the availability of data from all 29 metropolitan samples, we are able to disaggregate our analyses by levels of residential segregation, which cannot be done using other panels of the AHS because the metropolitan-area identifiers are suppressed for just over the majority of the units.

Our central dependent variable is derived from the new question on asthma, which is only asked of households with children between the ages of 6 and 17. Therefore, we restrict our analytical sample only to those households. The householder was asked whether a health provider has ever told her that any child in the home has asthma. If the householder said yes, the AHS field representative went through the household roster and asked the householder to respond exactly which children had asthma. From this assessment of child members with asthma, we created a dummy variable indicating

whether the household has any child reported to have had asthma versus having no children reported to have had asthma.[1]

Our key independent variable is comprised of the householder's race and ethnicity. We use four categories of race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and Asian and Pacific Islander[2]). Our other key independent variables gauge the housing conditions of the household's unit. We create a variable gauging the number of maintenance deficiencies in the housing unit counting the presence of the following conditions -- evidence of roaches or rodents in the unit; presence of mold; whether the unit has had toilet or heating breakdowns; and whether the unit has cracks/holes in the walls or ceiling, large patches of peeling paint/broken plaster, or leaks (from the inside of the home). In addition, we include dummy variables indicating the presence of the following housing conditions: household crowding; at least one smoker; and whether the home is rented. With respect to the neighborhood conditions, we are very limited because in the 2011 panel of the AHS, the Census Bureau removed most of the questions used in previous panels (e.g., trash/junk in the neighborhood, presence of abandoned buildings or buildings with bars on windows). The one variable that we include is the householder's rating of the neighborhood as a place to live, with 1 indicating the worst rating and 10 indicating the best rating.

We include a number of other control variables in our multivariate analyses that measure demographic characteristics of households as well as their socioeconomic status that might explain why racial and ethnic disparities exist in the prevalence of pediatric asthma. The demographic indicators include a dummy variable indicating whether the household is foreign born; the householder's age; and two other dummy variables – whether the household is headed by a female and by a married couple. We also examine variation in the number of children in the household. Socioeconomic status is gauged by several variables. Education is represented by three dummy

[1] We also created a variable indicating whether the household had more than one child reported to have had asthma, but we found the prevalence to be low so we did not pursue this analysis further.
[2] For simplicity, we refer to Asian and Pacific Islanders hereafter as Asians.

variables indicating whether the households has 1) less than a high school degree; 2) a high school degree; and 3) some college education (with at least a Bachelor's degree forming the reference group). We control for household income and include a dummy variable indicating whether the household receives public assistance. The number of years in the housing unit is included. Finally, we control for the geography of the housing unit at a very minimal level, including dummy variables for whether the housing unit is in the central city and for the unit's region (West is the reference group).

To fulfill our research objectives, we first conduct descriptive analyses examining whether racial and ethnic disparities exist in the prevalence of pediatric asthma. Second, we examine minority-white differences in the housing, demographic, socioeconomic, and geographic variables just discussed. For our multivariate analyses, we conduct stepwise logistic regression models. More specifically, we run three sets of models – one set examining the racial and ethnic disparities in pediatric asthma; another set examining whether racial and ethnic disparities in the child asthma are reduced or eliminated with the addition of our summary index of the number of maintenance deficiencies in the housing unit and controlling for demographic and socioeconomic characteristics; and a final set for doing the same analyses as the previous set except these analyses include the dummy variables for each of the housing conditions used to create the maintenance deficiency index rather than including the overall index.

To specifically examine the impact of residential segregation on the link between racial and ethnic inequality in housing and disparities in asthma, we restrict our analytical dataset to just white and black households in the 29 metropolitan areas included as metropolitan samples in the 2011 AHS. As discussed above, many of the historical forces that shaped segregation were most relevant to blacks as compared to Hispanics and Asians. We merged data on residential segregation between whites and blacks in 2010, as gauged by dissimilarity or D-scores, from the database accompanying Logan and Stults (2011) with data from the 29 metropolitan samples in the AHS. For our analyses we disaggregated the 29 metropolitan areas into three groups based upon their segregation levels – 1) high

segregation (i.e., D-scores greater than or equal to 65); 2) moderate segregation (i.e., D-scores between 51 and 65); and 3) low segregation (i.e., D-scores less than or equal to 51).[3] These cutoffs correspond roughly to the values at the 75th and 25th percentiles and therefore break the data into two smaller groups of roughly equal size (i.e., the high and low segregation groups) and one group that is roughly equal to the size of the two groups combined (i.e., the moderate segregation group).

With each of these segregation-based groups of data, we run the three stepwise regression models discussed above. We are particularly interested in evaluating the black-white disparity in pediatric asthma within each of these segregation groupings as we add variables gauging the housing conditions. Of most interest will be to determine whether the black-white disparity in asthma will be explained more by housing characteristics in the high segregated areas as compared to the middle and low segregated areas.

Results

What is the prevalence of pediatric asthma in metropolitan America of whites, blacks, Hispanics, and Asians? Table 1 addresses this question, presenting the percent of households with children 6 to 17 years of age within each racial and ethnic group that reported being told by a health professional that at least one child in that age range ever had asthma. These results show that, relative to whites, blacks are significantly more likely to have children with asthma; Hispanics have about the same prevalence of pediatric asthma; and Asians are significantly less likely to have children with asthma. The black-white disparity in children with asthma is about nearly 9 percentage points, with 27.09% of blacks having at least one child reported to have asthma relative to 18.45% of whites. The pattern of the differences found here are consistent with those found by Mehta et al. (2013) using data from the 1998-2008 NHIS. In their study black children's rate of asthma was 1.5 times that of whites. However, the absolute levels of the prevalence of pediatric asthma are slightly higher using data from

[3] See Appendix Table 1 for the metropolitan areas sorted in descending order by the D-score for whites and blacks.

the AHS. This could be due to the fact that the data from the AHS are at the household level and those from NHIS are at the person level. Not surprisingly, the findings here from the AHS diverge from those based upon data for New York City found by Rosenbuam (2008) who finds that Hispanics are more likely than whites to have asthma. This likely reflects the fact that the composition of Hispanics in New York City is much different than that in the U.S. as a whole.

<TABLE 1 HERE>

The remainder of Table 1 presents group differences in relevant housing, household, and geographic characteristics. Relative to whites, blacks and Hispanics live in poorer quality housing but Asians generally experience equal and sometimes better residential circumstances. With respect to the number of maintenance deficiencies, blacks and Hispanics have averages of .84 and .76 deficiencies, about 1.5 times the average for whites (.56). Asians have .49 mean maintenance deficiencies, which is significantly lower than the average for whites. It is likely that for blacks, this poorer housing quality is linked to their higher levels of pediatric asthma, compared to that of whites. Interestingly, however, although Hispanics have a significantly greater mean number of maintenance deficiencies, relative to whites, they are not more likely than whites to experience higher rates of pediatric asthma. The significantly lower level of average maintenance deficiencies of Asians, compared to that of whites, is consistent with their significantly lower levels of pediatric asthma.

Regarding the individual indicators of housing conditions, blacks and Hispanics reside in poorer quality housing, relative to whites, and Asians generally live in about equal quality housing, similar to the results above. Except for the indicator gauging the presence of rodents in the unit, blacks fare worse than whites on the other individual housing characteristics. On several indicators, including the presence of roaches in the unit, toilet and heating breakdowns, and cracks/holes in the walls or ceilings, twice as many black households as white households experience these issues in their housing units. The absolute levels of the percentages of blacks experiencing such conditions are generally low, except for indicators gauging the presence of cracks/holes in walls and ceilings (11.03%) and water

leaks (from inside) (13.94). It is also notable that 22.09% of black households report the presence of cockroaches, which in past research has been clearly linked to the prevalence of asthma. Blacks are twice as likely as whites to live in crowded and rental housing. Not surprisingly, their average number of years spent in their homes is significantly lower than for whites. They are also more likely to have at least one smoker in the home as compared to whites, and blacks are less likely than whites to rate their neighborhoods as good.

With respect to Hispanics, except for the indicators gauging the presence of rodents in the unit and water leaks (from inside), Hispanics fare worse than whites on the other individual housing problems. However, the magnitude of the differences with whites is not as large as was the case between blacks and whites. Hispanics are about 1.5 times as likely as whites to reside in homes with such negative conditions, including the presence of mold, toilet and heating breakdowns, cracks/holes in walls or ceilings, and large patches of peeling paint/broken plaster. The absolute levels of the percentages of Hispanics experiencing negative housing conditions are generally low, except for the presence of cockroaches, where more than 1 in 4 Hispanic households (or 26.74%) report such pests being in their homes. It is surprising that given how high the prevalence is of Hispanics reporting cockroaches in their homes they do not experience pediatric asthma at higher rates than whites. In terms of other related housing characteristics, Hispanics are more than five times as likely as whites to experience household crowding, more than twice as likely as whites to rent their homes, live in their homes for an average of fewer years than whites, and rate their neighborhoods lower than whites. Interestingly, however, a smaller share of Hispanic households report having at least one smoker in their homes, compared to whites.

Among minorities, Asians experience the best housing conditions. The only housing condition on which they suffer a disadvantage, relative to whites, is in the report of the presence of cockroaches in their units, but the magnitude of the difference is far lower than that for blacks and Hispanics (13.81% versus 10.12%). On three housing conditions – the presence of rodents in the unit, mold, and

cracks/holes in the walls or ceiling – Asians report significantly lower levels of these problems than whites. On the remaining conditions, Asians are equal to whites. Given these results, it is not surprising that Asians experience significantly lower levels of pediatric asthma than whites. On related housing characteristics, Asians are significantly more likely than whites to be crowded and live in rental housing. Not surprisingly, their average number of years spent in their homes is significantly lower than for whites. However, they are significantly less likely than whites to report having at least one smoker in their homes and are equal with whites in terms of the average rating that they give to their neighborhoods.

The remaining sections of Table 1 reveal a similar pattern of racial and ethnic differences in household demographic and socioeconomic characteristics, with whites and Asians exhibiting attributes that would make them more conducive to having better housing and health, Hispanics falling in the middle, and blacks having attributes that would make them the least conducive to having better housing and health. The percent of households headed by a foreign-born householder is 83.7% for Asians, 58.84% for Hispanics, and 11.53% for blacks, which are all significantly larger than for whites (5.82%). Because foreign-born individuals have been consistently shown to have better health outcomes than native-born individuals (e.g., Acevedo-Garcia et al. 2010), for Asians, the foreign-born "benefit" coupled with their superior housing quality, no doubt lowers their prevalence of pediatric asthma, relative to that of whites. For Hispanics, it is likely that their greater foreign-born composition provides a protective effect on their health that offsets their residence in poorer-quality housing. For blacks, the foreign-born composition is relatively low and does not appear to help them reduce their chances of asthma in light of their residence in much poorer quality housing than whites.

With respect to other demographic characteristics, black and Hispanic householders are significantly younger than white householders, although the magnitude of these differences is quite small. More important are the differences in the sex of the householder and family structure. Relative to whites, Asian householders are significantly less likely to be headed by females and significantly

more likely to be headed by married couples. However, black and Hispanics householders are significantly more likely than whites to be females and significantly less likely than whites to be part of married couples. The magnitude of the black-white differences on the family-related characteristics is particularly large. For example, blacks are about 54% less likely to reside in married-couple households than whites. These demographic differences, no doubt, play a role in the resources available to minority groups to contribute toward their housing quality and health. Racial and ethnic differences also exist with respect to the average number of children across these households, but the magnitude of these differences is quite small.

Not surprisingly, the patterns of racial and ethnic differences in the socioeconomic characteristics of households mirror the patterns found in the sex of the householder and family structure just discussed. Just over 42% of blacks and 66% of Hispanics have acquired a high school degree or less education, compared to only 7.9% of whites and just over 26% of Asians. The average household incomes of blacks and Hispanics are about half as large as those of whites. However, the average household income of Asians is slightly larger, although not significantly larger, than that of whites. Similarly, as compared to whites, the percent receiving public assistance is significantly larger among blacks and Hispanics but slightly (though not significantly) lower for Asians.

The final set of characteristics reported in Table 1 relate to the geography of the housing unit. All minority groups are significantly more likely than whites to live in the central city neighborhoods of the metropolitan area, although the magnitude of the differences is largest for blacks and Hispanics with twice as many of them living in central cities compared to whites. No doubt, this relates to their much poorer quality housing conditions discussed earlier. With respect to regional differences, the patterns are clearly dependent upon the racial and ethnic group. Relative to whites, blacks are equally likely to live in the Northeast, significantly less likely to live in the Midwest and the West, and significantly more likely to live in the South. Hispanics are significantly less likely than whites to live in the Northeast and Midwest and significantly more likely than whites to live in the South and West.

Asians are significantly less likely than whites to live in the Midwest and the South and are significantly more likely than whites to live in the West. However, they are equally likely as whites to live in the Northeast.

The question to which we now turn is how the racial and ethnic differences in the prevalence of pediatric asthma are mediated by these racial and ethnic differences in housing, household, and geographic characteristics, particularly for blacks who experience significantly higher levels of asthma, worse quality housing conditions, and lower socioeconomic status, compared to whites. Table 2 addresses this issue by presenting the logistic regression coefficients from three models – one reporting the unadjusted coefficients for householder race and ethnicity (column 1); another model controlling for the index of maintenance deficiencies and other demographic, socioeconomic, and geographic characteristics (column 2); and a final model that controls for the individual housing conditions, as well as demographic, socioeconomic, and geographic characteristics (column 3).

<TABLE 2 HERE>

Consistent with the descriptive analyses presented in Table 1, column 1 of Table 2 shows that black households with children are 1.64 times (i.e., exp(.496)=1.64) as likely as white households with children to have at least one child reported to have had asthma. Hispanic households with children, however, are .94 times as likely as white households with children to have at least one child reported to have had asthma, although this difference is not statistically significant. Column 1 shows that Asian households with children are significantly less likely -- .70 times as likely – as white households with children to have at least one child reported to have had asthma.

Controlling for relevant housing, household, and geographic characteristics, do racial and ethnic disparities continue to persist in predicting the prevalence of asthma? The results in column 2 reveal that black households with children experience greater levels of asthma relative to white households with children, controlling for these factors. However, it appears that the log odds of black households with children who have experienced asthma, relative to their white counterparts, have

declined from .496 to .351 after controlling for these housing, household, and geographic characteristics. The odds of black households with children having at least one child reported to have had asthma are 1.42 times the odds of their white counterparts, dropping by 13.5%. Interestingly, the model in column 2 reveals that the lower prevalence of Hispanic and Asian households having pediatric asthma relative to whites has reversed signs and turned into a minority-white disparity, although for Hispanics it is not statistically significant. For Asians, however, the odds of having at least one child reported to have had asthma are 1.21 (i.e., exp(.189)=1.21) times the odds of whites, controlling for relevant characteristics. Thus, when equalizing the very positive characteristics of Asians with others in the logistic regression model, Asians are significantly more likely than whites to have experienced pediatric asthma.

What happens to the racial and ethnic disparities when we control for individual housing conditions, rather than the index of maintenance deficiencies? Column 3 of Table 2 reports these specific results. Interestingly, the results are almost identical to those in column 2, indicating that none of the individual housing conditions explain the racial and ethnic disparities in any more unique way than the sum of the housing conditions. Controlling for these characteristics as well as householder and geographic characteristics, we find that the odds of black and Asian households having at least one child reported to have had asthma are 1.43 times (i.e., exp(.355)=1.43) and 1.21 times (i.e., exp(.191)=1.21), respectively, than the odds of their white counterparts. The difference between Hispanics and whites is not statistically significant.

As suspected and consistent with previous research, adverse housing conditions are significantly related to the prevalence of asthma among households with children. Column 2 reveals the number of maintenance deficiencies is significantly and positively related to the prevalence of pediatric asthma, controlling for other relevant factors. Column 3 shows that certain conditions are particularly important in raising the log odds of pediatric asthma. It appears that the presence of mold in the home, toilet breakdowns, and cracks/holes in the walls or ceilings are strongest in their impacts,

even more than education and the receipt of public assistance. More specifically, households living in homes with mold, toilet breakdowns, and cracks/holes in the walls or ceilings are 1.42 (i.e., exp(.352)=1.42), 1.38 (i.e., exp(.324)=1.38), and 1.42 (i.e., exp(.351)=1.42) times as likely as households without those specific conditions respectively, to have at least one child in the home reported to have had asthma, controlling for other relevant housing, household, and geographic characteristics. Households that report the presence of roaches and rodents as well as water leaks (from inside) are also significantly more likely to have at least one child reported to have had asthma in the home than those not reporting such housing problems, controlling for other relevant factors. In addition, households that are renters and give their neighborhoods lower ratings are also significantly more likely to have pediatric asthma than those who are owners and who rate their neighborhoods better, respectively.

In considering the other control variables in columns 2 and 3, it is notable that so few are statistically significant in their relationship to the log odds of pediatric asthma besides the variables gauging household education and receipt of public assistance mentioned above. One of the most important variables, however, is the nativity-status of householders, with households having foreign-born householders being about half as likely as those with native-born householders to have at least one child reported to have had asthma, controlling for other factors. Female headship and a greater number of children in the household both significantly raise the log odds of pediatric asthma relative to male headship and to households with fewer children, respectively, controlling for other housing, household, and geographic characteristics. Contrary to expectations, the central city location of a housing unit lowers the log odds of pediatric asthma compared to units in suburbs.

The objective that we now seek to fulfill is examining whether the pediatric asthma disparity specifically between blacks and whites is mediated by adverse housing conditions and ecological structural variables more in highly segregated metropolitan areas than in moderately and less segregated metropolitan areas. We turn to Table 3 to examine the results of our stepwise logistic

regressions stratified by the black-white segregation level of the 29 AHS metropolitan samples. The first panel shows the logistic regression models for households falling in metropolitan areas with high levels of black-white residential segregation. Column 1 reports the unadjusted log odds of the impact of race on the prevalence of pediatric asthma. In highly segregated metropolitan areas, the odds of black households having at least one child reported to have had asthma are nearly 2 times (i.e., exp(.676)=1.97) the odds of their white counterparts. Column 2 reveals that controlling for the number of maintenance deficiencies in the housing unit, as well as other relevant control variables, significantly decreases the effect of black race, with the odds of black households having pediatric asthma being 1.35 times those of whites.[4] Column 3 reveals a similar significant decrease in the effect of black race, when controlling for individual housing conditions as well as other relevant household, housing, and geographic characteristics.

<TABLE 3 HERE>

Turning to the second panel of Table 3 (columns 4-6), which presents the logistic regression models for households in moderately segregated metropolitan areas, we find that the black-white disparity in pediatric asthma is not mediated as much by housing and other characteristics, as it was in the highly segregated metropolitan areas. Column 4 shows that the log odds of blacks having asthma relative to whites is .417; after controlling for the number of maintenance deficiencies and other characteristics, the log odds decrease to .306 (column 5); and after controlling for individual housing conditions as well as other control variables, the log odds decrease to .308 (column 6). The differences in these coefficients from model 1 (column 4) are not statistically significant as was the case in the panel for households in highly segregated metropolitan areas. Without controls in place, the odds of black households having at least one child reported to have had asthma are 1.52 times the odds of

[4] We performed a significance test comparing the coefficients in model 1 to models 2 and 3. The z-scores were 2.87 and 2.79, respectively, thereby indicating that the changes in the log odds of black are statistically significant. Please note that we also ran models that included race, the housing characteristics, the neighborhood rating variable, as well as the indicators for housing tenure and central-city location (to gauge ecological structure) and the same significant decrease is found in the magnitude of the coefficient for race. We didn't have time to include the specific results of the models here, but we will highlight them in the PAA presentation.

white households. However, with controls in place for maintenance deficiencies (column 5) and individual housing characteristics (column 6), as well as other relevant residential, demographic, and socioeconomic variables, the odds of black households having pediatric asthma are 1.36 each, respectively, times the odds of white households.

Moving to the third panel of Table 3 (columns 7-9), which presents the logistic regression models for households in the least segregated metropolitan areas, we find that the black-white disparity in pediatric asthma is also not mediated as much by housing characteristics and other relevant variables, as it was in the highly segregated metropolitan areas. Column 7 shows that the log odds of blacks having pediatric asthma relative to whites is .501; after controlling for the number of maintenance deficiencies and other characteristics, the log odds decrease to .415 (column 8); and after controlling for individual housing conditions as well as other control variables, the log odds decrease to .438 (column 9). The differences in these coefficients from model 1 (column 7) are not statistically significant as was the case in the panel for households in highly segregated metropolitan areas. Without controls in place, the odds of black households having at least one child reported to have had asthma are 1.65 times the odds of white households. However, with controls in place for maintenance deficiencies (column 5) and individual housing characteristics (column 6), as well as other relevant variables, the odds of black households having pediatric asthma are 1.51 and 1.55, respectively, times the odds of white households.[5]

In all three panels of results in Table 3, adverse housing conditions are significantly related to the prevalence of asthma among households with children, regardless of the segregation levels in the metropolitan area. Consistent with the national-level analysis presented in Table 2, columns 2, 5, and 8 of Table 3 reveal that the number of maintenance deficiencies is significantly and positively related

[5] For households in the moderately and low segregated groups, we also ran models that included race, housing characteristics, the neighborhood rating variable, as well as the indicators for housing tenure and central-city location (to gauge ecological structure). In both sets of analyses, we found no significant difference between the coefficients for race between these models.

to the prevalence of pediatric asthma, controlling for other relevant factors. Columns 3, 6, and 9 show that certain conditions are particularly important in raising the log odds of pediatric asthma, also consistent with the overall analysis presented above. It appears that the presence of cockroaches and mold in the home are significantly and positively related to the log odds of pediatric asthma across all panels, controlling for other relevant factors. The coefficients for the presence of rodents in units and toilet breakdowns are significantly and positively related to the log odds of pediatric asthma in the high and moderate segregation panels, but in the low segregation models, the presence of rodents is not significantly related to pediatric asthma and the presence of toilet breakdowns are negatively related to the log odds of there being at least one child in the home reported to have had asthma. As far as other housing characteristics, contrary to expectations, crowding is significantly and negatively related to the log odds of pediatric asthma but only in the high segregation analyses, controlling for other relevant factors. Table 3 reports that households that rent their homes are significantly more likely than those who own their homes to have at least one child reported to have had asthma in high and low segregated contexts, controlling for other relevant control variables.

Similar to the overall, national-level analysis, within each panel of the segregation-specific analyses, there are few demographic and socioeconomic characteristics that are significantly related to the log odds of pediatric asthma. Within the high segregation grouping, households that are headed by females, married, have more children under 18, and less than a high school education are significantly more likely than those headed by males, not married, with fewer children under 18, and at least a college degree, respectively, to have at least one child reported to have had asthma, controlling for other relevant factors. Among households in the moderate segregation panel, those who have a householder who is female, married, and that have more children are significantly more likely to have pediatric asthma than those who have a householder who is male, not married, and with fewer children, respectively, controlling for other relevant factors. In addition, households headed by a foreign-born

householder are significantly less likely to have children reported to have had asthma relative to those headed by a native-born householder.

In the low segregation analysis, the same finding for nativity status is also present. Households headed by a female, with less than a high school degree, and whose households have more children, more household income, and receive public assistance are significantly more likely to have at least one child reported to have had asthma than those households headed by a male, with at least a college degree, and whose households have fewer children, lower household income, and do not receive public assistance, respectively. In addition to the finding for household income being contrary to expectations, the negative and significant coefficient for high school degree was also unexpected.

The last set of findings in Table 3, which gauge the effect of geographic characteristics on pediatric asthma are interesting in comparison to the overall results presented in Table 2. More specifically, in the high segregation grouping, households located in the central city have significantly higher log odds of having a child with asthma than those located in the suburbs, consistent with expectations based upon the literature on residential segregation. At the same time, however, in the low segregation panel, households located in the central city are significantly less likely to have pediatric asthma than those in suburbs. This pattern of results mirrors the unexpected pattern of results in Table 2 for the national-level analyses. With respect to the moderate segregation grouping, there is no effect of central city location on pediatric asthma. However, households in the South are significantly less likely to have pediatric asthma than those in the non-South, controlling for other relevant factors.

Discussion and Conclusions

The primary goal of this paper was to examine the roles that residential inequality and residential segregation play in impacting racial and ethnic disparities in pediatric asthma in metropolitan America. To fulfill this main goal, the analysis focused on fulfilling four main

objectives, which have now been achieved. First, we documented the racial and ethnic disparities in the prevalence of pediatric asthma. Consistent with other studies at the national level, we found that black households were significantly more likely than white households to have at least one child reported to have had asthma. The difference between whites and Hispanics, however, was not statistically significant. With respect to Asians, they were significantly less likely than whites to have at least one child in their households reported to have had asthma.

Our second objective was to examine the extent to which the pattern in racial and ethnic disparities in pediatric asthma reflected racial and ethnic inequalities in residential attainment as well as differences in demographic and socioeconomic factors between minorities and whites. Based upon our descriptive analyses, we found that the black-white disparity in pediatric asthma was likely attributable to the significant residential inequality found between blacks and whites as well as differences in family characteristics and socioeconomic status that put blacks at a significant disadvantage, relative to whites, in their access to better quality housing and in maintaining better quality health. Interestingly, although Hispanics suffered many disadvantages in their housing circumstances, as compared to whites, a large share of Hispanics are foreign-born, which may have offset the negative consequences of living in poorer quality housing. With respect to Asians, our descriptive analyses revealed that their significantly lower levels of asthma, compared to whites, is likely attributable to their residence in good quality housing, which is either comparable or slightly better than that of whites; the fact that the large majority are born outside of the United States; and to their equivalent demographic and socioeconomic characteristics, relative to whites.

Our third objective was to examine the extent to which racial and ethnic disparities in the pediatric prevalence of asthma are reduced or changed with controls for housing, household, and geographic characteristics. Using AHS data at the national level, we found that the black-white disparity in pediatric asthma was reduced but not eliminated by controlling for such variables and indeed remained statistically significant. A surprising result from the multivariate analysis was the

finding that with the addition of these controls, the Asian-white disparity in pediatric asthma went from being one where a lower percentage of Asians had children reported to have had asthma to just the opposite, with Asians now being more likely than whites to have at least one child reported to have had asthma. This finding could have been due to the addition of the control for nativity status in the logistic regression models. With respect to Hispanics, the results in the multivariate analyses were consistent with those from the descriptive analyses, revealing no statistically significant difference in pediatric asthma between Hispanics and whites. These logistic regression analyses also revealed that adverse housing conditions were significantly related to the prevalence of pediatric asthma among households with children and that few of the other demographic and socioeconomic characteristics significantly affected the log odds of the prevalence of pediatric asthma.

The fourth and final goal of the analyses undertaken here was to examine whether housing conditions and other relevant residential characteristics mediated the black-white disparity in pediatric asthma more in highly segregated metropolitan areas than in moderately and less segregated metropolitan areas. We found that indeed this was the case. The black-white disparity in pediatric asthma was mediated by these housing and residential characteristics much more for households residing in highly segregated metropolitan areas than was the case for households living in moderately and less segregated areas.

Taken together, these findings have important theoretical implications for the study of pediatric asthma. The results suggest that residential inequality and segregation are both important and appear to work together in explaining minority-white, and in particular black-white, disparities in pediatric asthma. Housing condition disadvantages faced by blacks contribute to their higher rates of pediatric asthma. Moreover, the way that historical and contemporary forces underlying residential segregation have ecologically shaped the differential access that blacks have to better quality housing, relative to whites, appears to be significant in influencing black-white disparities in asthma. Up until our study, no research, to our knowledge, has examined the influence of residential segregation on the prevalence

of asthma or pediatric asthma nor have any studies examined the close link between residential segregation and residential inequality and its impact on health outcomes, more generally.

Our findings, while still somewhat preliminary, suggest that additional research needs to be done to better document the impact of residential segregation on pediatric asthma. Future analyses, which we plan to undertake, should employ mediation analyses and more carefully document the mediating effect of housing conditions on disparities in pediatric asthma. In addition, subsequent research should explore other aspects of segregation that might impact the prevalence of pediatric asthma. For example, it would be extremely useful to include more measures gauging the environmental aspects of neighborhoods in which households live to further explore the role that segregation plays. It is likely that exposure to more traffic and lower air quality is more prevalent for households in highly segregated areas than is the case in less segregated areas. It would also be worth exploring whether different dimensions of residential segregation (i.e., centralization, clustering, isolation) affect the analyses presented here.

Future research should also seek to correct some of the other limitations present in the current analysis. For example, more detailed analyses need to be conducted contrasting the various groups within each race and ethnicity but particularly among Hispanics. The results presented here likely mask differences across subgroups of Hispanics that are significantly affected by residential segregation (e.g., Dominicans, Puerto Ricans). Future analyses should also be done of other indicators of asthma. Just focusing on the prevalence of pediatric asthma is limited. More should be done assessing children's use of medication and the severity of asthma. The data in the AHS are quite limited. Finally, subsequent studies should rely on multilevel modeling techniques to uncover the metropolitan-level factors as well as the neighborhood-level factors that shape residential segregation, residential inequality, and asthma.

In spite of these limitations, the findings here echo those of previous research in touting the importance of residential segregation in impacting racial and ethnic disparities in health. Our study,

however, suggests that simply controlling for the racial and ethnic composition in neighborhoods or D-scores at the aggregate level is insufficient in gauging the impact of segregation such outcomes. Segregation constrains the housing choices of minorities. Such constraints result in minorities living in poorer quality housing than whites, and in the end, children suffer from poorer health consequences. Given that minority births are outpacing white births, examining the quality of where minority households with children live as well as their health outcomes will be particularly important, as minorities collectively become the majority group in American society. If such inequalities and health disparities persist, this will have implications for how inequality may be transmitted for future generations of racial and ethnic minorities.

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Table 1. Asthma Prevalence and Housing, Household, and Geographic Characteristics of Households with Children (6-17) by Race/Ethnicity in Metropolitan America, 2011

	Percent:			
	Non-Hispanic Whites	**Non-Hispanic Blacks**	**Hispanics**	**Asians**
Variables	(1)	(2)	(3)	(4)
Asthma				
Presence of at least one child 6-17 with asthma	18.45	27.09 ***	17.53	13.68 ***
Housing characteristics				
Number of maintenance deficiencies (mean)	55.62	83.56***	76.48***	48.92*
Type of maintenance deficiency				
Evidence of:				
Roaches in the unit	10.12	22.09***	26.74***	13.81***
Rodents in the unit	19.34	17.79	16***	14.86***
Presence of mold in the home	4.34	6.2***	7.03***	2.50**
Toilet breakdowns	1.77	3.71***	2.91***	2.60
Heating breakdowns	2.27	4.84***	3.60***	1.86
Cracks/holes in walls or ceiling	5.57	11.03***	7.38***	3.36**
Large patches of peeling paint/broken plaster	1.80	3.97***	2.51**	1.25
Water leaks (from inside)	10.41	13.94***	10.32	8.70
Crowded	3.49	7.64***	19.22***	8.01***
At least one smoker	9.74	15.51***	4.61***	5.26***
Renter	21.82	57.03***	54.61***	30.40***
Duration in Household (mean)	8.60	6.62***	5.86***	6.66***
Rating of neighborhood (1=worst, 10=best) (mean)	8.14	7.42***	7.85***	8.07
Householder characteristics				
Foreign Born	5.82	11.53***	58.84***	83.70***
Age (mean)	43.57	41.94***	40.48***	43.46
Female	45.65	69.53***	48.49***	37.93***
Married household	74.14	40.08***	66.13***	82.61***
Kids under 18 (mean)	1.96	2.05***	2.21***	1.87**
Education				
Less than high school	5.80	13.32***	38.40***	9.72***
High school degree	2.10	28.76***	27.75***	16.40***
Some college education	32.21	37.05***	23.06***	21.14***
Total household income (in 1,000 of dollars)	98.75	48.39***	48.38***	99.23
Receives TANF or other public assistance	1.86	5.63***	4.82***	0.83
Geographic characteristics				
Central city location	23.95	50.09***	46.46***	37.24***
Region				
Northeast	20.39	19.91	15.28***	22.86
Midwest	26.34	18.75***	8.67***	13.89***
South	32.15	51.95***	33.95*	21.41***
West	21.10	9.40***	42.10***	41.83***
N	**15769**	**4857**	**6260**	**2102**

***p<.001; **p<.01; *p<.05 - differences refer to those between the minority group of interest and whites

Table 2. Logistic Regression Models Predicting Pediatric Asthma Prevalence of Households with Children (6-17) in Metropolitan America, 2011

	Model 1	**Model 2**	**Model 3**
Variables	(1)	(2)	(3)
Race/ethnicity (ref. white)			
Black	0.496***	0.351***	0.355***
	(0.038)	(0.044)	(0.044)
Hispanic	-0.063	0.080	0.086
	(0.039)	(0.049)	(0.049)
Asian	-0.356***	0.189*	0.191*
	(0.073)	(0.083)	(0.083)
Housing characteristics			
Number of maintenance deficiencies		0.207***	
		(0.015)	
Type of maintenance deficiency			
Evidence of:			
Roaches in the unit			0.112*
			(0.044)
Rodents in the unit			0.194***
			(0.039)
Presence of mold in the home			0.352***
			(0.063)
Toilet breakdowns			0.324***
			(0.088)
Heating breakdowns			-0.001
			(0.085)
Cracks/holes in walls or ceiling			0.351***
			(0.057)
Large patches of peeling paint/broken plaster			-0.001
			(0.096)
Water leaks (from inside)			0.222***
			(0.046)
Crowded		-0.107	-0.089
		(0.064)	(0.064)
At least one smoker		0.059	0.057
		(0.052)	(0.052)
Renter		0.129**	0.129**
		(0.041)	(0.041)
Rating of neighborhood (1=worst, 10=best)		-0.043***	-0.043***
		(0.008)	(0.008)
Householder characteristics			
Foreign Born		-0.702***	-0.696***
		(0.052)	(0.052)
Age		0.001	0.001
		(0.002)	(0.002)

Table 2 (cont'd). Logistic Regression Models Predicting Pediatric Asthma Prevalence of Households with Children (6-17) in Metropolitan America, 2011

	Model 1	**Model 2**	**Model 3**
Variables	(1)	(2)	(3)
Female		0.180***	0.177***
		(0.034)	(0.034)
Married household		0.037	0.037
		(0.038)	(0.038)
Kids under 18		0.142***	0.141***
		(0.017)	(0.017)
Education (ref. >=college degree)			
Less than high school		0.225***	0.224***
		(0.057)	(0.057)
High school degree		-0.072	-0.073
		(0.047)	(0.047)
Some college education		0.052	0.046
		(0.042)	(0.042)
Total household income (in 1,000 of dollars)		-0.001	-0.001
		(0.001)	(0.001)
Receives TANF or other public assistance		0.301***	0.298***
		(0.079)	(0.079)
Duration in Household		0.001	0.001
		(0.002)	(0.002)
Geographic characteristics			
Central city location		-0.089**	-0.084*
		(0.034)	(0.034)
Region (ref. West)			
Northeast		0.045	0.038
		(0.047)	(0.047)
Midwest		-0.084	-0.089
		(0.048)	(0.048)
South		-0.076	-0.061
		(0.042)	(0.043)
Intercept	-1.486***	-1.664***	-1.664***
	(0.020)	(0.127)	(0.127)
N	**28,988**	**28,988**	**28,988**

***p<.001; **p<.01; *p<.05

Table 3. Logistic Regression Models Predicting Pediatric Asthma Prevalence of Households with Children (6-17) in Metropolitan America Disaggregated by Black-White Segregation Levels, 2011

	High Segregation			Moderate Segregation			Low Segregation		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Race/ethnicity (ref. white)									
Black	0.676***	0.302**	0.309**	0.417***	0.306***	0.308***	0.501***	0.415**	0.438***
	(0.082)	(0.101)	(0.103)	(0.059)	(0.073)	(0.073)	(0.108)	(0.128)	(0.129)
Housing characteristics									
Number of maintenance deficiencies		0.218***			0.309***			0.226***	
		(0.040)			(0.027)			(0.046)	
Type of maintenance deficiency									
Evidence of:									
Roaches in the unit			0.381**			0.358***			0.538***
			(0.141)			(0.079)			(0.120)
Rodents in the unit			0.348***			0.321***			0.180
			(0.103)			(0.072)			(0.121)
Presence of mold in the home			0.687***			0.313*			0.434*
			(0.164)			(0.124)			(0.172)
Toilet breakdowns			0.747**			0.456**			-0.833*
			(0.279)			(0.171)			(0.420)
Heating breakdowns			0.213			0.265			-0.279
			(0.207)			(0.148)			(0.353)
Cracks/holes in walls or ceiling			0.306*			0.381***			-0.126
			(0.152)			(0.108)			(0.189)
Large patches of peeling paint/broken plaster			-1.382***			0.164			0.493
			(0.299)			(0.170)			(0.257)
Water leaks (from inside)			-0.071			0.205*			0.218
			(0.129)			(0.084)			(0.132)
Crowded		-0.756**	-0.571*		-0.001	-0.001		-0.204	-0.246
		(0.233)	(0.234)		(0.159)	(0.160)		(0.231)	(0.234)
At least one smoker		0.056	0.087		0.044	0.047		-0.089	-0.091
		(0.101)	(0.103)		(0.089)	(0.089)		(0.186)	(0.188)
Renter		0.206	0.241*		0.084	0.083		0.298**	0.284**
		(0.114)	(0.115)		(0.077)	(0.077)		(0.109)	(0.110)

Table 3 (cont'd). Logistic Regression Models Predicting Pediatric Asthma Prevalence of Households with Children (6-17) in Metropolitan America Disaggregated by Black-White Segregation Levels, 2011

	High Segregation			Moderate Segregation			Low Segregation		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Rating of neighborhood (1=worst, 10=best)		-0.012	-0.012		-0.014	-0.013		-0.016	-0.007
		(0.021)	(0.021)		(0.015)	(0.015)		(0.024)	(0.024)
Householder characteristics									
Foreign Born		0.121	0.153		-0.842***	-0.842***		-1.065***	-1.058***
		(0.211)	(0.212)		(0.131)	(0.132)		(0.198)	(0.199)
Age		0.005	0.005		-0.004	-0.004		0.001	-0.001
		(0.005)	(0.005)		(0.004)	(0.004)		(0.005)	(0.005)
Female		0.293***	0.264**		0.259***	0.265***		0.393***	0.399***
		(0.089)	(0.089)		(0.063)	(0.063)		(0.091)	(0.091)
Married household		0.225*	0.260*		0.184*	0.186*		-0.094	-0.109
		(0.101)	(0.103)		(0.072)	(0.072)		(0.101)	(0.102)
Kids under 18		0.237***	0.226***		0.139***	0.139***		0.118*	0.123*
		(0.042)	(0.042)		(0.031)	(0.031)		(0.049)	(0.049)
Education (ref. >=college degree)									
Less than high school		0.397*	0.377*		0.148	0.152		0.718***	0.739***
		(0.156)	(0.158)		(0.124)	(0.125)		(0.171)	(0.173)
High school degree		-0.006	-0.077		0.142	0.143		-0.280*	-0.282*
		(0.122)	(0.123)		(0.085)	(0.085)		(0.133)	(0.134)
Some college education		0.162	0.155		0.114	0.117		-0.072	-0.046
		(0.108)	(0.109)		(0.073)	(0.073)		(0.102)	(0.102)
Total household income (in 1,000 of dollars)		-0.001	-0.001		-0.001	-0.001		0.001**	0.001**
		(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)
Receives TANF or other public assistance		0.104	0.060		-0.220	-0.215		0.579*	0.554*
		(0.190)	(0.197)		(0.185)	(0.185)		(0.234)	(0.238)
Duration in Household		-0.001	-0.001		0.003	0.003		0.013*	0.013
		(0.006)	(0.006)		(0.004)	(0.004)		(0.006)	(0.006)

Table 3 (cont'd). Logistic Regression Models Predicting Pediatric Asthma Prevalence of Households with Children (6-17) in Metropolitan America Disaggregated by Black-White Segregation Levels, 2011

	High Segregation			Moderate Segregation			Low Segregation		
	Model 1	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**	**Model 1**	**Model 2**	**Model 3**
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Geographic characteristics									
Central city location		0.409***	0.430***		-0.022	-0.028		-0.206*	-0.218*
		(0.104)	(0.106)		(0.067)	(0.067)		(0.091)	(0.092)
Region (ref. non-South)									
South		-0.035	-0.048		-0.246***	-0.259***		-0.209	-0.202
		(0.114)	(0.122)		(0.060)	(0.063)		(0.135)	(0.136)
Intercept	-1.318***	-2.463***	-2.477***	-1.417***	-1.777***	-1.793***	-1.398***	-1.893***	-1.958***
	(0.047)	(0.310)	(0.315)	(0.034)	(0.229)	(0.229)	(0.044)	(0.339)	(0.342)
N	**3,749**	**3,749**	**3,749**	**7,828**	**7,828**	**7,828**	**3,719**	**3,719**	**3,719**

***p<.001; **p<.01; *p<.05

Appendix Table 1. 29 AHS Metropolitan Areas by Levels of Black-White Residential Segregation

	2010 Census Data		
Metropolitan Area	**Black-White D-Score**	**Black Population**	**Percent Black**
Milwaukee	79.61	270,518	17.39
Cleveland	72.56	429,802	20.69
Buffalo	70.99	144,455	12.72
St. Louis	70.65	537,484	19.11
Cincinnati	66.90	273,562	12.84
Birmingham	65.22	322,183	28.56
Los Angeles	64.99	876,512	8.93
Indianapolis	64.50	278,581	15.86
New Orleans	63.33	400,452	34.29
Pittsburgh	63.07	216,539	9.19
Memphis	62.22	607,230	46.14
Columbus	59.95	294,789	16.05
Denver	59.37	156,360	6.15
Kansas City	58.64	272,469	13.39
Atlanta	58.35	1,733,046	32.89
Oakland	56.63	307,786	12.03
Fort Worth	56.30	283,224	13.26
Dallas	55.07	699,410	16.51
Sacramento	54.45	178,639	8.31
San Francisco	54.13	85,057	4.79
Charlotte	53.08	431,726	24.56
Providence	50.81	86,791	5.42
San Diego	48.37	173,327	5.60
Virginia Beach	46.89	537,971	32.18
Riverside	43.96	336,944	7.98
Phoenix	41.31	225,946	5.39
Portland	40.90	80,138	3.60
San Jose	38.59	52,208	2.84
Anaheim	34.87	55,919	1.86

Source: Logan and Stults 2011; http://www.s4.brown.edu/us2010.