"Racial Disparities in Asthma: Does Place Matter?"

BACKGROUND

Within the United States, asthma disproportionately burdens black, Latino, and poor children (1). Individual-level risk factors do not fully account for the observed differences (2, 3). Nor does income explain the racial disparities (4, 5). Recently, researchers have begun to look to contextual factors. Health risks and resources appear to be spatially and socially distributed across neighborhoods, with asthma-inducing pathogenic risk factors concentrated in poor, segregated neighborhoods (2, 6). Given that African Americans are far more likely to reside in hyper-segregated neighborhoods (7), conditions specific to such places may drive disparities in asthma.

Despite the theoretical and empirical evidence linking neighborhood context to asthma, the overwhelming majority of research on racial disparities in asthma to date focus on individual or family-level factors, such as exposure to indoor allergens (8), health behaviors (9, 10), stress (11, 12), and genetic predisposition (13). These studies overlook how social context patterns or potentiates individual risk factors. Ecological studies, on the other hand, often do not control for correlated individual and family-level factors that may drive the racial disparities in asthma.

In this paper, I address this gap by examining the role of segregation and the spatial location of racial and ethnic groups, above and beyond individual risk factors, in explaining racial and ethnic disparities in adult asthma. My choice of asthma as an outcome is motivated both by its significance as a public health concern, as well as the differential distribution of asthma by race and geographic area. By decomposing racial/ethnic disparities in asthma prevalence into within- and between-area components, I consider the extent to which a racial/ethnic group's spatial location relative to other racial/ethnic groups is linked to individual racial/ethnic disparities in asthma. Such analyses are needed in order to disentangle the relative contribution of residential context versus individual or family-level attributes to asthma and to answer the question: does place matter for racial disparities in health?

Specifically, the paper asks three research questions: 1) Do racial/ethnic disparities in the asthma prevalence persist, after controlling for potentially confounding individual factors? 2) To what extent do these disparities attenuate after adjusting for neighborhood context? 3) Are racial disparities in asthma linked to the differential distribution of sociodemographic, physical and social characteristics across neighborhoods?

METHODS

Data

The data come from Chicago Community Adult Health Study (CCAHS), a multi-stage probability samples designed to investigate neighborhood effects on individuals. From 2001 to 2003, the CCAHS collected neighborhood data on 3105 adults, aged 18 and older, who lived in 343 Chicago-based neighborhood clusters (NCs). One individual was interviewed per household, with a response rate of 71.8 percent. The CCAHS also assesses the built environment through systematic social observations (SSO). A total of 13,251 block faces were rated. These were nested within 343 NCs.

Several factors motivate these choices of data. The CCAHS offers a rich source of individual-level data about the respondents' past and current health, early life and current experiences, financial status, and relationships. The community survey also provides valuable information about structural neighborhood characteristics (residential stability, concentrated disadvantage social and physical environment, and neighborhood processes (collective efficacy). Moreover, unlike most survey-based data on neighborhood quality, the SSO offers an additional, independent source of information about the neighborhood conditions that is reliable and ecologically valid. Finally, the neighborhoods, composed of all neighborhoods in Chicago, IL, represent a range of race/ethnic and socioeconomic compositions, though each neighborhood population is homogenous with respect to racial or ethnic mix, socioeconomic status, and family structure. At the same time, the asthma rates in Chicago, one of the highest in the country, vary significantly across neighborhoods. Thus, the CCAHS data have the necessary within- and between-neighborhood variation in asthma, and racial and SES composition, for multilevel modeling.

MEASURES

Asthma prevalence. The outcome of interest is asthma, a self-reported dichotomous measure derived from the following two questions: (a) "Has a physician or medical professional ever diagnosed you with asthma?" and (b) Have you had asthma in the last 12 months?"

Individual Covariates

Primary sociodemographic factors. Epidemiological evidence suggests a patterning of asthma prevalence by gender, marital status, age, and socioeconomic status   We therefore include the following basic demographic factors: *race* (categorized into [1] non-Hispanic black, [2] Hispanic, with non-Hispanic white as omitted category), *age* (categorized into [1] 18 to 29, [2] 30 to 39, [3] 40 to 49, [4] 50 to 59, [5] 60 to 69, and [6] 70 and over), *gender*, and *marital status* (dummy variables categorized into [1] separated/ divorced, [2] widowed, [3] never married), *current family income* (dummies categorized into [1] less than $5,000, [2] $5,000-$9,999, [3] $10,00-29,999 [4] $30,000-$49,999, with $50,000 and up as omitted variable), and *educational attainment* (categorized into [1] less than high school, [2]some high school [3] high school degree, [4] some college, [5] college degree, with some graduate school as omitted category).   Additionally, childhood SES may influence subsequent asthma onset through selection into future neighborhood residence. Measures of childhood socioeconomic status include father's educational attainment (measured as above), and father's social class, a typology formulated by Erik Olin Wright (14).

Health/Health Care. Because obesity, an identified risk factor for adult asthma (15) is more prevalent among the African American community, analyses will adjust for *body mass index* (BMI), a continuous variable based on the respondent's body weight and height (measured by the interviewer). Analyses will also include dummies for *chronic bronchitis* and *emphysema/chronic obstructive lung disease,* given its symptom similarities to asthma (16), as well as *cigarette use* because of the higher smoking rate among residents in disadvantaged areas (17). Finally, dichotomous variables for *health insurance* (with 1 coded as "insured") and *regular source of medical care* (where 1 represents a "having a regular doctor or clinic") will be included to account for the potential underdiagnosis of asthma due to differential access.

Neighborhood-level Exposures

Sociodemographic structure. Four census-based neighborhood level variables characterize the sociodemographic structure of Chicago. The first factor, *concentrated disadvantage,* is characterized by strong positive loadings on the percentage of families with incomes of less than $10,000, in poverty, on public assistance, or female-headed; the percentage of unemployed adults in the civilian labor force or never-married adults; and negative loadings on percentage of families with incomes of $50,000 and over and the percentage of owner-occupied homes. The second factor, *neighborhood affluence/ gentrification,* loads positively on percentage of adults with 16 or more years of education, or in professional or managerial occupations, and percentage of people ages 18-29 or 30-39; it has negative loadings on the percentage of people who lived in the same residence in 1995 and the percentage under age 18. The third factor, *racial/ethnic/immigrant composition*, has strong positive loadings for percent Hispanic or foreign-born and negative loadings for percent non-Hispanic black. The final factor captures *older age composition*, with positive loadings for percent over the age of 70 or between ages 50-69, and negative loadings for the percent between ages 18-29 and the percent never married.

Neighborhood Physical and Social Characteristics. I also consider several social and physical neighborhood factors that may mediate the association between neighborhood structural characteristics and asthma prevalence. *Air pollution* measures the extent to which the interviewers experienced any irritation in their mouth, nose, or eyes from the air on the street during their observations (with 1 representing "no irritation" and 3 representing a lot"). Self-reports of neighborhood rodent/roach infestation are linked to higher levels of asthma-related allergens from these pests (18); as such, *neighborhood infestation* is used to indicate respondents' assessment of the frequency of rat, mice, or roach sightings in their neighborhood.   Because housing deterioration is prevalent in disadvantaged areas and is predictive of high household allergen levels (19), *neighborhood physical decay* will measure the proportion of face blocks that contain any of the following: vacant houses; burned-out, boarded-up, or

abandoned commercial/ industrial buildings; burned-out, boarded-up or abandoned houses; badly deteriorating residential units; or badly deteriorated recreational facilities. All scales are standardized to have a mean of zero and a standard deviation of one. Because exposure to traffic-related noise has also been identified as a risk factor for respiratory diseases, I will utilize two dummies for noise pollution: *heavy traffic* and *noisy streets*.

Perceived violence is a five-item mean-score scale indicating respondents' assessment of how often (where responses are coded as 1 for "never" and 4, "a lot/very often") the following occurred in the last six months: [1] a fight in the neighborhood with weapons, [2] a violent argument between neighbors, [3] gang fights, [4] sexual assault or rape; and [5] a robbery or mugging. Finally, *perceived danger is* a 2-item scale indicating the respondents' assessment of [1] how safe it is (where responses are coded as 1 for "completely safe" and 4 "extremely dangerous") to walk around alone in their neighborhood after dark, and [2] whether there is any place within 3 blocks of their home where the respondents are afraid to walk alone at night (with 1 representing "no," 2 "depends," and 3 "yes").

ANALYTIC STRATEGY

The aim of my analysis is to assess whether disparities in racial/ethnic disparities in asthma persist when variation in neighborhood context is accounted for. I accomplish this through a 3-stage modeling strategy. In the first stage, I examine the relationship between asthma and individual-level predictors, ignoring neighborhood context. The goal of these analyses is to provide a baseline estimate of racial disparities in asthma from which to compare subsequent models. An initial model will regress asthma on race and a limited set of individual-level covariates. An additional model will include a more expansive set of potential individual-level confounders that either a) may explain racial disparities in asthma (smoking, obesity or b) may drive both asthma rates and neighborhood selection.

In the second stage of my analysis, I examine how adjusting for neighborhood context changes the estimates of individual-level asthma disparity by restricting racial comparisons to people who share the same residential neighborhoods. Removing the across-neighborhood components from the fixed estimates of asthma disparities is a way of asking: do blacks and whites living in the same neighborhood differ in their risk of asthma? Such analyses allow me to parse out whether and to what extent neighborhood versus individual-level variation may explain the excess risk of asthma among blacks. Random intercept models (with individuals in level 1 and neighborhoods at level 2) will be estimated first on the more limited and then with more extensive set of individual- and family-level covariates.

In the final analysis stage, I identify potential mechanisms through which neighborhoods may lead to racial disparities in asthma by incorporating neighborhood-level variables into the hierarchical model. Unlike the previous model, this approach imposes a structure on the neighborhood model and has two comparable advantages. First, the multilevel structure provides an empirical test of the relative contribution of neighborhood factors to asthma prevalence in general, and racial disparities more specifically. Second, it offers more power to detect within-neighborhood disparities by comparing individuals living in similar neighborhoods (i.e., share certain neighborhood characteristics) rather than restricting comparisons to people who live in the same neighborhood. Neighborhood-level structural features will be introduced into hierarchical logit models. To determine whether the sociodemographic neighborhood characteristics may really be proxies for other underlying neighborhood dimensions, additional models will sequentially introduce a range of social/physical neighborhood measures.

HYPOTHESIZED RESULTS AND CONTRIBUTIONS

This study will contribute to the existing literature on social disparities in health in two ways. First, it employs multilevel methods to simultaneously examine individual and neighborhood-level variation in asthma. Few existing studies use similar techniques to assess the relative contribution of neighborhood-level risk factors; none, to my knowledge, focus on the role of segregation in asthma. Second, I exploit multiple forms of neighborhood-level measures, including a newly released community survey and systematic social observations, to examine the associations between social disparities in asthma and disparities in specific neighborhood characteristics, including air pollution, violence, and concentrated disadvantage. As noted above, most multilevel or ecological asthma research has focused

on the physical environment, overlooking the key role of the social environment (e.g., violence, stress) in influencing asthma.

Based on existing research an initial examination of the data, I hypothesize:

- Compared to non-Hispanic whites and Hispanics, non-Hispanic blacks will exhibit higher prevalence rates for asthma, even when confounding for individual factors.
- Racial disparities will attenuate significantly after adjusting for neighborhood context.
- Neighborhoods will vary significantly with respect to asthma prevalence, with the highest concentration in areas of high disadvantage and poor sociodemographic characteristics.
- Neighborhood physical and social characteristics, such as high violence, lack of safety, and pollution, will mediate the relationship between neighborhood structural features and racial disparities in asthma, such that the inclusion of these characteristics will reduce the effect size for neighborhood structural features to non-significance.

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