PRETERM BIRTH RISK IN NEW YORK CITY'S

ETHNIC AND IMMIGRANT ENCLAVES

Susan Marshall Mason

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Approved by:

Jay Kaufman (Chair)

Julie Daniels

Michael Emch

Vijaya Hogan

David Savitz

ABSTRACT

SUSAN M. MASON: Preterm birth risk in New York City's ethnic and immigrant enclaves
(Under the direction of Dr. Jay S. Kaufman)

Residential segregation of ethnic groups in the United States (US) results in ethnic enclaves that isolate non-white ethnic groups from resources available to whites. But enclaves may also reduce exposure to discrimination, provide a context for political organizing and, among immigrants, slow adoption of detrimental American health behaviors. The net influence of segregation on health may be ethnic- or immigrant-group specific, but most studies of ethnic density in the US have focused on the black population alone.

Using geocoded New York City birth records for 1995-2003 and a spatial measure of ethnic density computed from 2000 US Census data, this dissertation investigated 1) the risk of preterm birth among seven ethnic groups associated with residence in an ethnic enclave, 2) the risk of non-Hispanic black preterm birth associated with Hispanic, Asian, non-Hispanic white, and non-Hispanic black ethnic density, and 3) the risk of preterm birth among African-, Caribbean-, and US-born non-Hispanic black women associated with residence in African, Caribbean, and US-born neighborhoods.

Adjusted risk differences comparing ethnic enclaves (>25% ethnic density) to lower-density neighborhoods ranged from -13.6 per 1,000 (-16.6, -9.5) among whites to 5.6 per 1,000 (95% CI: 0.7, 10.5) among blacks. Hispanic and Asian responses to ethnic density were smaller, but tended to be protective, especially in poorer neighborhoods. Among non-Hispanic blacks, preterm birth risk was reduced in Hispanic neighborhoods relative to white ones (RD=-9.6 per 1,000 births; 95% CI: -16.6, -2.5). Increasing black African and Caribbean immigrant density was associated with increased risks of preterm birth among African- and Caribbean-born non-Hispanic black women, especially in poorer neighborhoods, but this effect was small compared to the substantial detrimental effect of US-born black density on US-born black preterm birth risk (RD=12.5 per 1,000; 95% CI: 6.6, 18.4).

The results suggest that US-born blacks are uniquely harmed by segregation into enclaves, particularly if their neighborhoods are poor. The protective effect of enclaves on other ethnic groups, and, for black women, of residence in Hispanic neighborhoods, points to the potential for psychosocial factors to counteract material deprivation.

To Austin, the sanest person I know.

To my parents, Anne and Brooks Marshall, who kept us afloat.

And to Finn, just because.

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LIST OF ABBREVIATIONS

APCU .... Adequacy of Prenatal Care Utilization

CI .... Confidence Interval

FIPS .... Federal Information Processing System

LMP .... Last Menstrual Period

MSA .... Metropolitan Statistical Area

NAD .... North American Datum

NDI .... Neighborhood Deprivation Index

PTB .... Preterm Birth

RD .... Risk Difference

SF1 .... Census Summary File 1

SF3 .... Census Summary File 3

SF4 .... Census Summary File 4

TIGER .... Topologically Integrated Geographic Encoding and Referencing

US .... United States

CHAPTER 1

INTRODUCTION AND AIMS

Social science investigations have documented substantial detrimental effects of racial residential segregation on the economic, social, and physical well-being of black Americans. A minority of investigations has, however, found that black health is better in black neighborhoods than in non-black ones, and the few studies focusing on Hispanics and Asians have generally documented protective effects of ethnic density. Theoretically, the material deprivation typically associated with black, Hispanic, and Asian ethnic enclaves may be health-eroding, while the social environments may protect health by offering shelter from discrimination, enabling social ties, and/or providing a context for political organizing.

This dissertation includes three studies that were designed to address the following gaps in the literature on ethnic density and health. First, most previous studies addressing the ethnic density-health association in the United States have focused on the black population, to the exclusion of Hispanics and Asians. Second, studies focusing on the health of black individuals have compared those living in black neighborhoods to those living in non-black neighborhoods, without disentangling the potentially different health effects of Hispanic, Asian, and white neighborhoods. Third, few investigations have specifically examined the health outcomes of immigrants residing in immigrant enclaves, even though many hypothesized reasons for immigrants' better health, such as social support, are likely to be dependent on close geographic proximity of other immigrants.

The three dissertation studies use a spatial measure of segregation and geocoded New York City birth records data from 1995 to 2003 to investigate the following questions:

1. What is the relationship between residence in an ethnic enclave and preterm birth risk among non-Hispanic white, non-Hispanic black, Spanish Caribbean, Central American, South American Hispanic, East Asian, and South Asian women?
2. Does the preterm birth risk of non-Hispanic black women differ depending on whether they live in neighborhoods with non-Hispanic whites, Hispanics, Asians, or other non-Hispanic blacks?
3. How does neighborhood immigrant density affect the preterm birth risk of African- and Caribbean-born non-Hispanic black women?

CHAPTER 2

BACKGROUND THEORY AND EVIDENCE

2.1 Preterm Birth

Preterm birth, defined as birth before the 37th week of gestation, is an important cause of infant mortality (death before the age of one year) and the leading cause of neonatal mortality (death in the first 28 days after birth) in the United States (US) (1). Despite intensive efforts on the part of US researchers, government agencies, and non-profit organizations, attempts at reducing the rate of preterm birth (PTB) have been largely unsuccessful (2, 3). Decreasing rates of infant mortality over recent decades are due in large part to medical technologies that have improved survival of infants born preterm (1, 4), but these advances do not prevent the extensive morbidity that accompanies birth at the earliest gestational ages. Furthermore, substantial heterogeneity in PTB rates across racial, Hispanic, and immigrant (ethnic) groups (5) contributes to long-standing ethnic disparities in infant mortality (6, 7), with the burden of preterm birth resting most heavily on populations that have the least access to life-saving medical advances (8).

Prevention of preterm birth is hindered by a limited understanding of its etiology and a lack of established risk factors amenable to intervention

(2). Few traditional socio-demographic, medical, or behavioral measures have been consistently linked with PTB. Of the established risk factors, the most predictive (e.g. black race and history of preterm birth (1)) are immutable and likely to be proxies for an underlying set of risk factors rather than causes in and of themselves (9). Other risk factors for preterm birth do not appear to explain the racial and ethnic differences in preterm birth rates. For example, the long-standing two-fold excess risk of preterm birth among black women when compared to white women appears to exist at every level of education and income (10). Some risk factors, including tobacco use, have been found to be less prevalent among black women than white women (11, 12). Characteristics found more often in the black population, such as short inter-pregnancy intervals (13) and out-of-wedlock births (11), have been only inconsistently linked to PTB (1, 11), while others, such as adolescent births, appear to be positively correlated with PTB in white but not black populations (14).

Although disparities in preterm birth have been most widely documented in black and white populations, there is additional heterogeneity of birth outcomes across other ethnic and immigrant groups. For example, Hispanic birth outcomes tend to be similar to white birth outcomes, despite the lower average educational attainment and income of the Hispanic population in the US; this propensity toward favorable outcomes has become known as the "Hispanic paradox" (15-17). Further heterogeneity has been identified within racial/ethnic groups on the basis of nativity, with foreign-born women of a given racial or ethnic group generally at reduced risk of preterm birth when compared to their US-born counterparts (the "nativity effect") (5, 18-22). Many East and South Asian groups appear to exhibit little nativity effect (23, 24), however, with some studies finding foreign-born East Asians to be at increased risk of poor birth outcomes when compared to their US-born counterparts (25). In addition, studies have found considerable variation in outcomes within black, Hispanic, and Asian immigrant groups depending on region of origin (16, 18, 26). For example, foreign-born South/Central American blacks living in New York City are at reduced risk of giving birth preterm when compared to foreign-born Caribbean blacks (18).

Contextual and psychosocial factors have emerged as potentially important determinants of the distribution of PTB risk across populations. Some researchers hypothesize that access to resources is not fully captured by traditional socioeconomic measures, such as individual income or education, and that these unmeasured factors drive the ethnic variation in preterm birth rates. For example, geographic access to health-promoting resources such as nutritious food, medical care, and safe housing may be more constrained for non-whites than for whites (27, 28), and a growing body of literature has documented an association between neighborhood resources and poor birth outcomes, controlling for individual-level socioeconomic status (27, 29-32). Moreover, the gap between black and white preterm birth rates appears to be somewhat narrowed in contexts where black and white women have similar access to contextual-level resources, such as in the military (33) or in high-income neighborhoods (34).

Social environments may additionally influence the risk of poor birth outcomes through their impact on chronic stress (29, 35-39). Black women have been found to have higher self-reported stress than white women (40, 41), are disproportionately exposed to stressful situations such as discrimination (42), negative life events (42, 43) and/or residence in neighborhoods characterized by social disorganization and crime (27, 40), and stress and stressful situations have been found in some studies to be associated with preterm birth (27, 41-45).

Chronic stress is immunosuppressive (37, 38, 46). Measures of chronic stress have been found to be positively correlated with bacterial vaginosis in pregnancy (40, 47), which is more prevalent among black than white women (6, 47, 48), and is thought to be an important cause of spontaneous preterm birth (6, 38, 48). Stress may also play a direct role in the hormone cascade that results in preterm labor: corticotropin-releasing hormone, which is centrally involved in the stress response, has been implicated in the shift from a progesterone- to estrogen- dominant intrauterine environment that precedes labor (37).

Similarly, deficiencies in certain micronutrients such as antioxidants are thought to compromise immune function (49), potentially leading to genitourinary tract infections and subsequently to preterm birth. Chronic stress and poor nutrition, as well as lead exposure, may also be risk factors for endothelial dysfunction and the hypertensive disorders of pregnancy (6, 49), which may motivate labor induction before term, and for fetal growth restriction (6), which may lead to spontaneous preterm birth (50).

These hypothesized mechanisms articulate links from the social environment to preterm birth through a physiologic stress response, and from the resource environment to preterm birth through poor nutrition or exposure to toxic substances. The resource and social contexts may also interact to create distinct risk environments. For example, a poor resource environment may be less harmful in a tightly knit community that provides a buffer of social support or maintains strong norms regarding nutrition and substance use. The specific combination of social and material factors in a neighborhood may depend on its ethnic composition, which is in turn influenced by residential segregation patterns.

2.2 Residential Segregation, Ethnic Density, and Health

Residential segregation, defined as the uneven distribution of population subgroups across a geographic region (51), is a powerful means of social stratification in the US, limiting the economic and educational opportunities of non-white populations, most notably black Americans (52, 53). Although segregation of blacks has declined somewhat in the post-civil rights decades (54), levels of black segregation remain high, with almost half of the US black population living in metropolitan areas that have been described as hypersegregated (52), extremely segregated areas characterized by completely racially homogeneous neighborhoods (i.e., 100% black or 100% white) surrounded by neighborhoods that are similarly homogeneous (55). Some US cities are so segregated that Massey (52) has compared them to apartheid-era South Africa.

Racial segregation between blacks and whites cannot be explained by racial socioeconomic differences, as rich blacks are nearly as segregated from whites as are poor blacks (52), and segregation on the basis of social class is much lower than racial segregation, indicating that race trumps class as a criterion for geographic stratification (54). Furthermore, the residential clustering of blacks cannot be attributed to blacks' preference for predominantly black neighborhoods, since most black individuals express preferences for residence in racially mixed neighborhoods (56). In contrast, survey results suggest that most whites prefer majority-white neighborhoods, and a substantial proportion prefer all-white neighborhoods (56). This white preference for white neighborhoods is manifested not only through whites' choice of residence, but is also enforced through discriminatory practices. For example, Massey and Lundy (57) found that speakers of "black vernacular" English were given access to far fewer apartments than were speakers of middle-class English when inquiring about advertised rental units using a standardized script; for example, more than 75% of attempts on the part of male middle-class English speakers resulted in access to rental housing, compared to 45% of attempts on the part of male black vernacular English speakers.

Segregation of other minorities, such as Hispanics and Asians, is less pronounced than that of blacks (54, 58-60), but is increasing with the growth of these populations (60, 61). Unlike blacks, most Hispanic and Asian groups become increasingly integrated with whites as their social status rises (59). Puerto Ricans appear to be an exception to this general rule, with high rates of segregation from whites in all social classes (59, 62). Massey attributes this to many Puerto Ricans' African heritage; whites avoid Puerto Ricans either because they perceive them to be black or because Puerto Ricans' willingness to reside near African Americans results in segregation from whites as a spurious result of whites' avoidance of African American neighborhoods (62). Like Puerto Ricans, other immigrant groups that are perceived as black by white Americans have difficulty gaining access to white neighborhoods, even as they become assimilated and their social status rises (63). As a result, these groups often settle near African American areas, but may maintain distinct cultural and socioeconomic characteristics (64, 65).

Ethnic residential segregation is manifested at the neighborhood level by the creation of ethnically dense neighborhoods. These ethnic enclaves are likely to have specific combinations of material and social factors that may influence preterm birth risk among their residents (51). While much theoretical and empirical work suggests that segregation undermines the well-being of blacks, there may also be positive correlates of ethnic density for Hispanics and Asians, and for blacks in certain contexts.

The argument that segregation harms non-white ethnic populations generally focuses on the detrimental effect ethnic segregation appears to have on individual- and contextual-level material resources. In particular, sociologists have suggested that racial segregation isolates blacks from educational and economic opportunities (e.g., the "spatial mismatch hypothesis") (53, 66, 67). In support of this hypothesis, Massey et al. documented substantial detrimental effects of racial residential segregation on the social and economic well-being of African Americans in Philadelphia, suggesting that segregation has played an important role in perpetuating the black-white gap in socioeconomic status (68).

In addition to its apparent influence on individual economic well-being, racial segregation translates the uneven distribution of wealth across ethnic groups into geographically concentrated pockets of poverty that disproportionately disadvantage non-white individuals with regard to community resources. Massey shows that racial residential segregation translates secular declines in black incomes, as observed in the 1970s, into increased black exposure to neighborhood poverty, even in the absence of segregation by socioeconomic status (66, 69). Thus, available evidence suggests that ethnic segregation is responsible, at least in part, for reduced incomes among black individuals and creates conditions of chronic poverty to which both poor and non-poor blacks are exposed.

While ethnic density of non-white groups tends to be correlated with material disadvantage, the social environment of ethnic enclaves may be health-promoting. In particular, ethnic density may promote social organization and social trust. Sampson and Groves (70) found ethnic homogeneity to be positively associated with a community's ability to control adolescent peer groups (a measure of social organization) in Britain, and in turn with lower crime rates, adjusting for community socioeconomic status. Similarly, Putnam (71) documents a strong positive relationship between ethnic homogeneity and both inter- and intra-racial social trust in the US. Ethnographic work by Hutchinson et al. (72) suggests that, even in communities where members of different ethnic groups have cordial neighborly relationships, individuals' opinions of one another are colored by negative stereotypes based on race and ethnicity, which may undermine social trust in heterogeneous communities.

Ethnic residential homogeneity may also prevent discriminatory interactions or provide a context for political organizing. Pickett et al. assert that residing in an ethnic enclave may prevent non-whites from seeing themselves "through the eyes of the majority community" (73) (p.320) as members of a stigmatized group. Bledsoe et al. (74) found that residence in black-majority neighborhoods is associated with feelings of black solidarity and that increased racial solidarity is associated with greater involvement in black-focused organizations and increased political participation.

Residence in an enclave may provide additional and unique protections to immigrants by discouraging the adoption of negative health behaviors associated with assimilation into American society. Leiberson (75) documented an inverse association between segregation of immigrants from the native-born and measures of assimilation, such as immigrants' ability to speak English, likelihood of having citizenship, and rates of intermarriage with the native born, controlling for length of residence in the US. Duany (65) found that Dominican enclaves in New York City retained many central characteristics of Dominican culture, including food choices and language use. These findings suggest that residential isolation of immigrants from the native-born reduces the extent of assimilation with the majority. If maintenance of country-of-origin norms is beneficial, as has been suggested for Hispanics (76, 77), then segregation from the majority population may protect health by preventing or slowing the replacement of traditional cultural norms with American behaviors.

Epidemiologic studies of residential segregation have overwhelmingly focused on the black population (78), and have generally found higher levels of segregation to be correlated with poorer black health outcomes, including low birth weight (79-81), preterm birth (82, 83), infant mortality (84-90), adult all-cause mortality (88, 91-100), poor self-rated health (101, 102), overweight (103), cancer risk (104), tuberculosis (105), sexually transmitted disease rates (106), injection drug use prevalence (107), intentional injury (108), and homicide victimization (109).

A handful of studies have, however, found neighborhood-level racial homogeneity to be protective in the black population. For example, Roberts (31) found decreased risks of low birth weight among infants born to black women living in predominantly black neighborhoods in Chicago. Fang et al. (110) and Inagami et al. (111) documented reduced all-cause mortality rates among black Americans living in predominantly black neighborhoods in New York City. Pickett et al. (112) found that black women benefited from living in wealthier neighborhoods in Chicago only if the neighborhoods were predominantly black (not mixed), surmising that the negative effects of discrimination experienced by black women in white neighborhoods undermined the positive effects of increased access to neighborhood resources. These findings were replicated by Vinikoor et al. in North Carolina (113). Bell et al. (114) reported that black women in Metropolitan Statistical

Areas characterized by highly segregated neighborhoods had improved birth outcomes if the black neighborhoods tended to be clustered in the same area, hypothesizing that racial density across a larger region could be translated into political power. Kramer and Hogue report similar findings for very preterm birth (115).

Studies on ethnic density have been limited by a lack of attention to non-black groups such as Hispanics and Asians. A handful of studies indicate that the effects of ethnic density among Hispanics are more favorable than among blacks. Results among Mexicans suggest that higher Mexican neighborhood density is associated with improved self-rated health (116), decreased depressive symptoms (117), lower all-cause mortality (118), reduced incidence of cancer (119), decreased symptoms of poor physical health (120), and increased consumption of traditional foods, including legumes, corn, and tomatoes (121). Likewise, Inagami et al. documented reduced adult Latino mortality rates in New York City in predominantly Latino neighborhoods when compared to predominantly black neighborhoods (though Latino mortality rates were lowest in white neighborhoods) (111). Finally, county-level Mexican density was associated with a mortality reduction among infants born to Mexican American women in one study (122).

The findings regarding Hispanic density are not uniform, however: one study found no effect of Hispanic density on Hispanic low birth weight (80), another found no association with tuberculosis rates (105), while two others documented increased depressive symptoms (123) and health risk behaviors (124) in Hispanic enclaves. Osypuk et al. found that Hispanic immigrant enclaves were associated with lower consumption of high-fat foods and had better food availability (125), but were also associated with lower levels of physical activity.

The role of ethnic density in Asian American health outcomes remains largely unexamined. One study (126) found that Asian women residing in Asian enclaves were less likely to smoke than those living in mixed-ethnicity areas. Osypuk et al. found that, like Hispanics, Chinese residents of Chinese immigrant enclaves consumed fewer high-fat foods, but were exposed to several negative neighborhood factors (125). In the United Kingdom, there is some suggestion that increased Indian and Pakistani density is associated with reduced rates of depression (127) and lower alcohol consumption (128), but because of the different historical and current ethnic context in the United Kingdom it is unclear whether these results are generalizable to the US.

Studies on ethnic density effects have been limited not only by a lack of attention to potential heterogeneity across groups such as Hispanics and Asians, but have also ignored variation within the black population. First, most studies focusing on black health outcomes have asked only whether black individuals fare better in black or "non-black" neighborhoods, so little is know about whether different "non-black" areas – non-Hispanic white, Hispanic, or Asian neighborhoods – influence black health differently. Second, studies to date have not examined the ways that ethnic density may affect black immigrants differently from their US-born counterparts.

Growing ethnic diversity in the US makes it increasingly likely that black individuals have Hispanic and Asian neighbors in addition to black and white ones, and the social and material environments experienced by black residents are likely to depend not only on the presence of other blacks, but on the presence of specific non-black populations. For example, white neighborhoods tend to be wealthier than black ones, while Hispanic neighborhoods are often poorer (111). On the other hand, the potential benefits of Hispanic enclaves for Hispanic residents, such as access to healthful foods (121), may extend to members of other ethnic groups living nearby. Two studies indicate that black health outcomes may differ across neighborhoods depending on the specific non-black ethnic composition, although their findings are conflicting. Masi et al. report slightly reduced odds of black preterm birth associated with residence in Hispanic relative to white neighborhoods in Chicago (129), while Inagami et al. (111) found higher age-adjusted non-Hispanic black mortality in Hispanic neighborhoods relative to white ones in New York City.

The black population itself, like the residential contexts in which black individuals live, is increasingly diverse, due to recent waves of immigration from Africa and the Caribbean (60). Black immigrants, like foreign-born Hispanics (25), appear to have better health outcomes than their US-born counterparts (130-135). Positive immigrant health outcomes are often attributed to healthful country-of-origin foods (136), which are likely to be more accessible in immigrant areas, and to social support (77), which may be facilitated by close residential proximity of those with shared language and cultural affiliations. Ethnic density may therefore be central to the immigrant health advantage, but the effects of ethnic density on black immigrant health outcomes in the US have not been explicitly investigated.

2.3 Measuring Ethnic Density

The two most commonly used measures of segregation are the index of isolation and the index of dissimilarity, which are aggregate measures that describe the degree to which, on average, one population subgroup occupies different neighborhoods (or census tracts) than other subgroups or is unevenly distributed across neighborhoods in a region (51, 137). These indices are most often used in analyses of the association between Metropolitan Statistical Area (MSA)-level segregation and MSA-level disease rates (81, 85, 87, 91-93, 97, 102-104, 109, 114), although at least two studies have computed the indices of dissimilarity or isolation within a single region (88, 105). The majority of these MSA-level studies have found a higher prevalence of ill health among blacks living in more highly segregated MSAs (81, 85, 87, 88, 91, 92, 97, 102-105), but because the indices that are employed measure the average neighborhood context for the entire black population in an MSA, they do not reveal whether black neighborhoods themselves have higher rates of disease.

More recent studies have attempted to better understand the effects of living in particular kinds of neighborhoods that arise from segregation (31, 79, 80, 94-96, 101, 110-112). In this latter type of studies, the term "segregated neighborhood" generally describes a predominantly non-white or immigrant neighborhood within a heterogeneous city, and segregation is most often measured by the racial/ethnic composition of the neighborhood, where neighborhood is operationalized as some administrative unit such as a census tract. Results of neighborhood-level studies have been less consistent than those of MSA-level studies, with several studies showing a protective effect of living in segregated neighborhoods on black health outcomes (31, 110-112).

Tract-level racial composition and the indices of isolation and dissimilarity are called "aspatial" measures of segregation, because they treat each census tract or other administrative unit as if it were in a vacuum without regard to the organization of units in the region (51, 138). Aspatial indices have been criticized because they are subject to the "checkerboard problem" (Figure 2.1) and the "modifiable areal unit problem" (Figure 2.2) (51).

Figure 2.1 The checkerboard problem. Two hypothetical cities with equal populations and proportions of black residents; numbered cells indicate census tracts and darker shading indicates greater tract-level proportions of black residents.

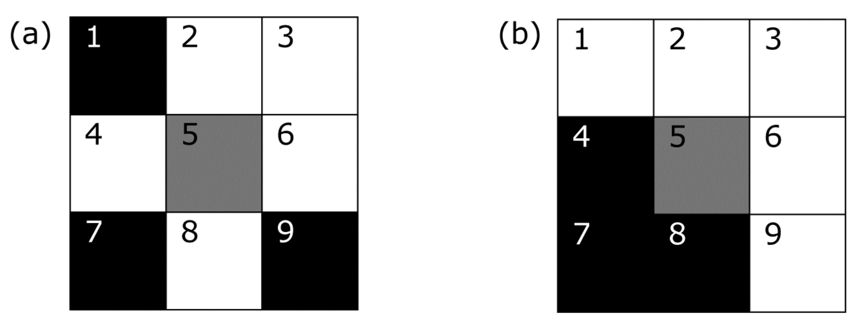


Figure 2.2 The modifiable areal unit problem. Hypothetical city from Figure 2.1(a), with original census tracts 4, 5, 7, and 8 combined into a single tract.

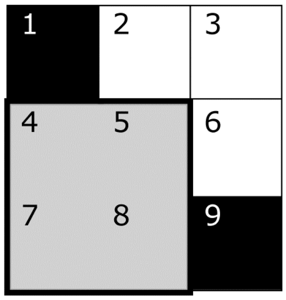


Figure 2.1 shows two possible configurations of census tracts in a city; the indices of dissimilarity and isolation would describe both of these configurations as equally segregated, though qualitatively one would typically say configuration (a) is less segregated than configuration (b). This is the checkerboard problem. In contrast, if census tracts 4, 5, 7, and 8 from Figure 2.1(a) were combined into a single unit (Figure 2.2), then the indices of isolation and dissimilarity would show reduced segregation, when in fact the underlying racial distribution across the city remained the same, illustrating the modifiable areal unit problem. Tract-level black proportions, similarly, would not change from Figures 2.1(a) to 2.1(b), but would change from Figure 2.1(a) to 2.2. The fact that aspatial measures of segregation may be insensitive to true changes in the racial distribution across a region and sensitive to changes in the boundaries of administrative units (or to changes in the level of aggregation) has raised concerns about their validity (139).

Spatial indices of segregation have been developed in an attempt to better capture the ethnic composition of neighborhoods across a region. A small number of papers have used spatial indices in investigations of the effect of segregation on preterm birth and low birth weight (79, 114). In an analysis of MSAs across the US, Bell et al. (114) computed, in addition to the more traditional (aspatial) index of isolation, the index of clustering, a spatial measure of the extent to which predominantly black census tracts are contiguous. The study reported that, although the MSA-level aspatial isolation of blacks was related to lower birth weight and greater risk of preterm birth among US-born black women, spatial clustering was protective against those outcomes holding isolation constant (114); in other words, black women who lived in cities where they were likely to reside in predominantly black neighborhoods were better off (in terms of their birth outcomes) if those black neighborhoods were clustered together.

In a neighborhood-level study, Grady (79) used a measure of local spatial isolation that represents black women's exposure to non-blacks both within their census tract of residence as well as in adjacent census tracts, finding that increased isolation is associated with a slight increase in risk of low birth weight among black women in New York City (79).

Morenoff (80) used a spatial lag model to determine the extent to which, after accounting for individual factors, contextual-level characteristics in a woman's neighborhood (clusters of census tracts in Chicago) and adjacent neighborhoods accounted for variation in low birth weight. The results suggested that the characteristics of adjacent neighborhoods were almost as predictive of a woman's birth outcome as were the characteristics of her neighborhood of residence. The spatial autocorrelation found in this study highlights the potential importance of areas beyond an individual census tract for the patterning of health outcomes. In addition, the results suggest that the influence of contextual-level characteristics decays with distance.

CHAPTER 3

DATA AND METHODS

3.1 Overview

Geocoded New York City birth records from 1995 through 2003 and a spatial measure of neighborhood ethnic density, computed from 2000 US Census data, were used to conduct three cross-sectional studies that aimed to answer the following questions: 1. What is the association between residence in an ethnic enclave and preterm birth among non-Hispanic white, non-Hispanic black, Spanish Caribbean Hispanic, Central American Hispanic, South American Hispanic, East Asian, and South Asian women? 2. Does the risk of preterm birth among non-Hispanic black women differ depending on whether their neighborhoods are non-Hispanic black, Hispanic, Asian, or non-Hispanic white? 3. Is residence near other African-, Caribbean-, or US-born non-Hispanic blacks associated with the risk of preterm birth among African-, Caribbean- and US-born non-Hispanic black women, respectively?

3.2 Data Sources and Management

Three data sources were used for the investigations: New York City birth records from 1995 through 2000, tract-level 2000 US Census population data, and Topologically Integrated Geographic Encoding and Referencing (TIGER) files.

3.2.1 New York City Birth Records

New York City birth records from January 1, 1995 through December 31, 2003 provided outcome (gestational age), ethnicity, and individual-level covariate data on all births occurring in New York City over the study period (N=1,084,882). The birth records were geocoded and each observation was assigned a 1990 or 2000 census tract number (depending on the year of birth) by the New York City Department of Health and Mental Hygiene.

Births were excluded if they resulted from multiple gestation pregnancies (N=17,526), since multiple gestations have especially high risks of preterm birth that are thought reflect an etiologic pathway distinct from preterm birth among singletons (1). Births were also excluded if the maternal residence was outside of New York City (N=14,780), if they were missing information on maternal census tract of residence (N=108,433), if they were assigned a census tract number that did not exist in either the 1990 or 2000 Censuses (N=1,812), if they were given an ambiguous census tract number[*] (N=62), or if they were geocoded to census tracts with a population of zero according to the census (N=28). Births missing gestational age information (N=6,418) were also excluded, as were births without the race or ethnic origin information necessary to create maternal ethnic group categories

[*] The tract numbers were stored in the birth records in such a way that census tract 36061000202 could only be distinguished from 36061020200 using the zip code variable; if the zip code was missing then the census tract number was ambiguous.

(N=8,801). The remaining 927,022 records accounted for 88% of all singleton births occurring to residents of New York City over the study period.

The New York City Department of Health and Mental Hygiene assigned 1990 tract numbers to births occurring in the 1990s and 2000 tract numbers to those occurring in the 2000s. Several census tracts split or merged between the 1990 and 2000 Censuses. For consistency over the study period, geographies that changed across the censuses were represented by the larger of the 1990 or 2000 Census tracts. Specifically, nine 1990 US Census tracts were absorbed into another tract in the 2000 Census, so these nine tracts were assigned the corresponding 2000 tract number. Likewise, 30 year 2000 tracts that had been split from 15 1990 tracts were merged back to their "parent" tracts and assigned the 1990 tract numbers. Following New York City Department of City Planning documentation (140), an additional 29 tracts were updated to correct 1990 errors. After updating, there were 2,168 unique tract numbers in the birth records.

3.2.2 US Census Data

Tract-level population counts and covariate data were obtained from the 2000 US Census via the American FactFinder website (factfinder.census.gov). Summary File 1 (SF1) provided ethnic group and total population counts for all 2217 tracts in the five counties of New York City. Population counts for non-Hispanic black African and Caribbean immigrants, needed for Aim 3 analyses, were obtained from Summary File 4

(SF4), which includes information on 2,105 census tracts; the SF4, which is based on sample data, contains fewer census tracts than the SF1 because the US Census Bureau suppresses information pertaining to tracts with less than 50 unweighted sample cases (141). Area-level covariates were obtained from Summary File 3 (SF3). Details on the specific variables and files from which they were obtained are provided in Table 3.1.

In order to match the birth records, 30 tracts in the 2000 US Census data that had split from 15 tracts between 1990 and 2000 were merged back to their "parent" tracts and assigned the 1990 tract numbers. These re-created 1990 tracts were given summary values of the variables associated with the smaller (split) tracts. (Counts from the smaller tracts were summed. Median values were weighted by the total tract populations and then averaged.) There were 2,202 unique census tract numbers remaining after updates. Information on the 32 census tracts that did not appear in the birth records (i.e. that had no births) is provided in Appendix 3A; most of these tracts had very small populations. Tract 1 in the Bronx, with a 2000 population of 12,780 but no births, corresponds to Riker's Island Prison.

Table 3.1 Tract-level variables used in the analysis, with corresponding census variable names and numbers

ANALYSIS VARIABLE (TRACT-LEVEL)	FILE	CENSUS VARIABLE(S)	CENSUS VARIABLE NUMBER(S)
Ethnic density	SF1	Total population	P004001
		Non-Hispanic white population	P004005
		Non-Hispanic black population	P004006
		Hispanic population	P004002
		Asian population	P004008
Immigrant density	SF4	African-born non-Hispanic black population	PCT048022
		Caribbean-born non-Hispanic black population	PCT048044
Percent with < high school education	SF3	Total population aged 25+	P037001
		Males: no schooling, …,12th grade, no diploma	P037003, …, P037010
		Females: no schooling, …, 12th grade, no diploma	P037020, …, P037027
Percent males not in the labor force	SF3	Total population, males aged 16+	P043002
		Males aged 16+ not in labor force	P043008
Percent unemployed	SF3	Total male civilian population aged 16+ in labor force	P043005
		Total female civilian population aged 16+ in labor force	P043012
		Males aged 16+ unemployed	P043007
		Females aged 16+ unemployed	P043014
Percent renter-occupied households	SF3	Total number of occupied housing units	H007001
		Renter occupied housing units	H007003
Percent crowding (>1 person/room)	SF3	Total number of occupied housing units	H020001
		Owner occupied: 1.01, …, 2.01+ occupants per room	H020005, …, H020007
		Renter occupied: 1.01, …, 2.01+ occupants per room	H020011, …, H020013
Percent below poverty level	SF3	Total population for whom poverty status is determined	P087001
		Individuals with income below poverty level in 1999	P087002
Percent female-headed families	SF3	Total number of family households	P010006
		Female headed family households, children aged <18	P010015

Table 3.1, continued Tract-level variables used in the analysis with corresponding census variable names and numbers

Analysis Variable (tract-level)	File	Census Variable(s)	Census Variable Number(s)
Percent income <$30,000 per year	SF3	Total number of households <$10,000 per year, …, $29,999 per year	P052001 P052002, …, P052006
Percent on public assistance	SF3	Total number of households Households on public assistance	P064001 P064002
Percent no vehicle	SF3	Total number of occupied housing units Owner-occupied with no vehicle available Renter-occupied with no vehicle available	H044001 H044003 H044010
Percent males in profession	SF3	Total employed civilian males aged 16+ Males aged 16+ in professional occupations	P050002 P050010
Percent females in profession	SF3	Total employed civilian females aged 16+ Females aged 16+ in professional occupations	P050049 P050057
Percent males in management	SF3	Total employed civilian males aged 16+ Males aged 16+ in management occupations	P050002 P050004
Percent females in management	SF3	Total employed civilian females aged 16+ Females aged 16+ in management occupations	P050049 P050051
Median household income	SF3	Median household income in 1999 Total number of households	P053001 P010001
Median individual income	SF3	Median earnings for individuals aged 16+ with earnings Total number of individuals aged 16+ with earnings	P085001 P084001
Median value of housing units	SF3	Median value of owner-occupied housing units Total number of owner-occupied housing units	H085001 H084001
Residential stability	SF3	Total population aged 5+ Population aged 5+ in same house since 1995	PCT021001 PCT021002

3.2.3 TIGER Files

Computation of the spatial ethnic density exposure, a proximity-weighted measure of the neighborhood population with a given ethnic or immigrant identity, required estimating the residential proximity of each mother in the birth records to various ethnic groups in the city. Because they were the smallest unit available in the birth records, census tracts were used to locate each woman geographically, and between-tract distances were used to estimate her distance to other populations. New York City census tracts are geographically small, with a mean area of 0.35 square kilometers (0.14 square miles) and a median area of 0.18 square meters (0.07 square miles).

For the purposes of estimating between-tract distances, Topologically Integrated Geographic Encoding and Referencing (TIGER) files containing 2000 Census tract boundary layers for the 5 counties of New York City were downloaded in shapefile format from the ESRI website (arcdata.esri.com/ data/ tiger2000/ tiger_download.cfm). The TIGER files used North American Datum (NAD) 1983 as the geographic coordinate system. Census tracts were identified with Federal Information Processing (FIPS) codes.

The TIGER files were uploaded into ArcGIS (ESRI) and projected in Universal Transverse Mercator NAD 1983 Zone 18. Tracts that had split since 1990 were merged to recreate the original 1990 geographies and were reassigned 1990 FIPS codes. Estimated tract centers (centroids) were positioned using a center-of-mass calculator (142), which computes the geographically-weighted center of each tract. The center of mass was chosen over ESRI centroids (the default in ArcGIS) because the ESRI centroids were highly influenced by tract “appendages” often resulting in a centroid that was on or near the tract boundary.

The point-distance calculator in ArcGIS was used to compute between-centroid distances for each tract, and several distances were validated by hand-measuring them. Between-tract distances were computed within each county, but not across counties, in order to reduce the data processing required; this assumes that a census tract in one county is infinitely far from, and has no influence on, a census tract in another county. This condition was thought to be reasonable because, with the exception of Kings and Queens Counties, New York City counties are separated by water.

The between-tract distances were exported and uploaded into SAS 9.1. The datasets had three variables: a “from” FIPS code, a “to” FIPS code, and the distance, in meters, between the two tracts. The distance from a census tract to itself was zero.

The between-tract distances were merged with tract-level population counts and area-level covariates from the 2000 US Census by matching the census FIPS codes to the “to” FIPS in the distance dataset. Ethnic group, immigrant group, and total populations in each “to” tract were weighted and then summed over each “from” tract as described in section 3.3.2 below. The birth records data were merged by matching on the “from” FIPS variable.

3.3 Variable Construction

3.3.1 Outcome

A preterm birth was defined as a live singleton birth at greater than 20 but less than 37 completed weeks of gestation (1). The clinical estimate of gestational age was used instead of estimates based on last menstrual period (LMP), because imperfect recall and individual variation in time from LMP to ovulation have been found to contribute to inaccuracies in LMP-based measures of gestational age (143-145). Because clinical estimates of gestational age take into account both LMP and ultrasound information, they are likely to be more accurate than estimates based on LMP alone.

The outcome included both spontaneous and induced preterm birth. Though potentially etiologically distinct, previous studies have found that risk factors do not differ substantially for the two types of preterm birth (146), possibly reflecting shared etiologic mechanisms. Supplemental analyses were, however, conducted in which models were re-run with medically indicated preterm births (identified using linked hospital discharge data) excluded.

3.3.2 Exposures

Neighborhood-level ethnic or immigrant density was defined as the percentage of the population in a woman's area of residence that self-identified on the census as having a given ethnic or immigrant identity. Following Reardon and Firebaugh (138), the areas nearest a woman were assumed to contribute most to her experience of neighborhood-level ethnic density. Populations farther away were allowed to influence her estimated exposure as well, but this influence decayed with distance. Because they were the smallest unit available in the birth records, census tracts were used to locate the women geographically, and the distance from each woman's residence to other populations was estimated using the distances between-census tract centroids, computed as described in section 3.2.3.

Specifically, the "proximity-weighted ethnic density" (Π_{JM}) for a woman belonging to ethnic group *M* and residing in census tract *J* was calculated by multiplying the population count of ethnic group *N* in each census tract *K* (x_{KN}) by a weight (p_{JK}) that represents the proximity of blocks *J* and *K*. These weighted ethnic populations were summed and then divided by total census tract populations (x_K) that were weighted in the identical manner. This produced a weighted percent as shown below:

$$\Pi_{JM} = \frac{\sum_{K}(x_{KN} \times p_{JK})}{\sum_{K}(x_{K} \times p_{JK})}$$

The proximity weight (p_{JK}), a "biweight kernel", allows census block *K*'s influence to decay in an approximately Gaussian manner with its distance from census block *J* (147):

$$p_{JK} = \left(1 - \frac{(d_{JK})^2}{r}\right)^2 \text{ if } r<c\text{, else } p_{JK}=0$$

Where d_{JK} is the distance between census blocks *J* and *K*. Note that if *J*=*K*, then d_{JK}= 0 and p_{JK}= 1; that is, a census block's own ethnic composition will have maximal influence on the estimated exposure of the residents of that census block.

The variable *r* is the distance from census block *J* beyond which there is no influence on *J's e*stimated ethnic density. The value of the radius, *c*, is chosen based on the hypothesized area thought to meaningfully affect the environment of those living in census block *J*. Lee and colleagues (147) suggest four radii that correspond to potentially meaningful spaces: 500 meters approximates areas accessible on foot, 1000 meters and 2000 meters correspond to school districts and police zones, and 4000 meters covers the distance often traveled by vehicle to work, church, and the supermarket. In a dense urban area, such as New York City, the walkable 500m area was thought to best represent an individual's neighborhood.

3.3.3 Ethnic and Immigrant Groups

Two variables, ethnic origin and race, were used to identify maternal ethnic groups in the birth records (Figure 3.1). The ethnic origin variable was used to divide women into Hispanic and non-Hispanic categories; a woman was categorized as non-Hispanic if she placed her ethnic origin in a non-Spanish-speaking country and as Hispanic if she reported an ethnic origin from a Spanish-speaking country or as "Hispanic". The Hispanic category was set to missing if the ethnic origin variable was missing or was recorded as "Other South American", since it was impossible to tell whether this corresponded to a Spanish-speaking South American nation.

Women reporting their ethnic origin from a Spanish-speaking country were categorized based on United Nations region definitions into three Hispanic categories: Spanish Caribbean, Central American and Mexican, and South American Hispanic (148).

Women who reported their ethnic origin as non-Spanish-speaking and their race as "White" or "Black" were categorized as non-Hispanic white or non-Hispanic black, respectively.

East Asians and South Asians were categorized based on United Nations regions. East Asians included women reporting non-Spanish-speaking ethnic origins and a race of "Chinese", "Japanese", or "Korean". In addition, women reporting "Other" or "Other Asian" race were included in the East Asian group if they also reported ethnic origins in China, Japan, Korea, or Mongolia (148). Similarly, South Asians included women reporting non-Spanish-speaking ethnic origin and "Asian Indian" race or those who reported "Other" or "Other Asian" race who also reported ethnic origins in Afghanistan, Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan, or Sri Lanka (148).

Foreign-born non-Hispanic black women (N=112,959) were further divided into African- and Caribbean-born categories using the country of birth variable in the birth records (Table 3.2). Less than 1% (N=1,745) of non-Hispanic black records were missing the country of birth variable.

The ethnic group categories excluded 13,923 women with non-Hispanic ethnic origins that were not white, black, East Asian, or South Asian and 25,212 women who reported a Hispanic ethnic origin not in the Spanish Caribbean, Central America, or South America (the majority of these were women who reported their ethnic origin as "Hispanic"). These exclusions accounted for 4.2% of the 927,022 births with complete geographic, ethnicity, and outcome data.

Ethnic group-specific population counts for each census tract were downloaded from Summary File 1 of the 2000 US Census as shown in Table 3.1. Similarly, African and Caribbean non-Hispanic black immigrant population counts were downloaded from Summary File 4 of the Census as shown in Table 3.1. The 2000 US Census allowed individuals to identify more than one racial identity, but fewer than 3% did (149), and for simplicity (and to avoid double-counting individuals reporting two or more races) the ethnic populations are based on those reporting a single race only.

These ethnic population counts were used to compute four ethnic density exposures (non-Hispanic white, non-Hispanic black, Hispanic, and Asian) and three ethnic/immigrant density exposures (African-born non-Hispanic black, Caribbean-born non-Hispanic black, and US-born non-Hispanic black), as described in section 3.3.2.

Figure 3.1 Identification of seven maternal ethnic groups from the New York City birth records for 1995 through 2003. Dashed lines indicate records that were excluded because of missing data. There were 25,212 Hispanic women who could not be categorized as Spanish Caribbean, Central American or South American and 13,923 non-Hispanics who could not be categorized as white, black, East Asian, or South Asian.

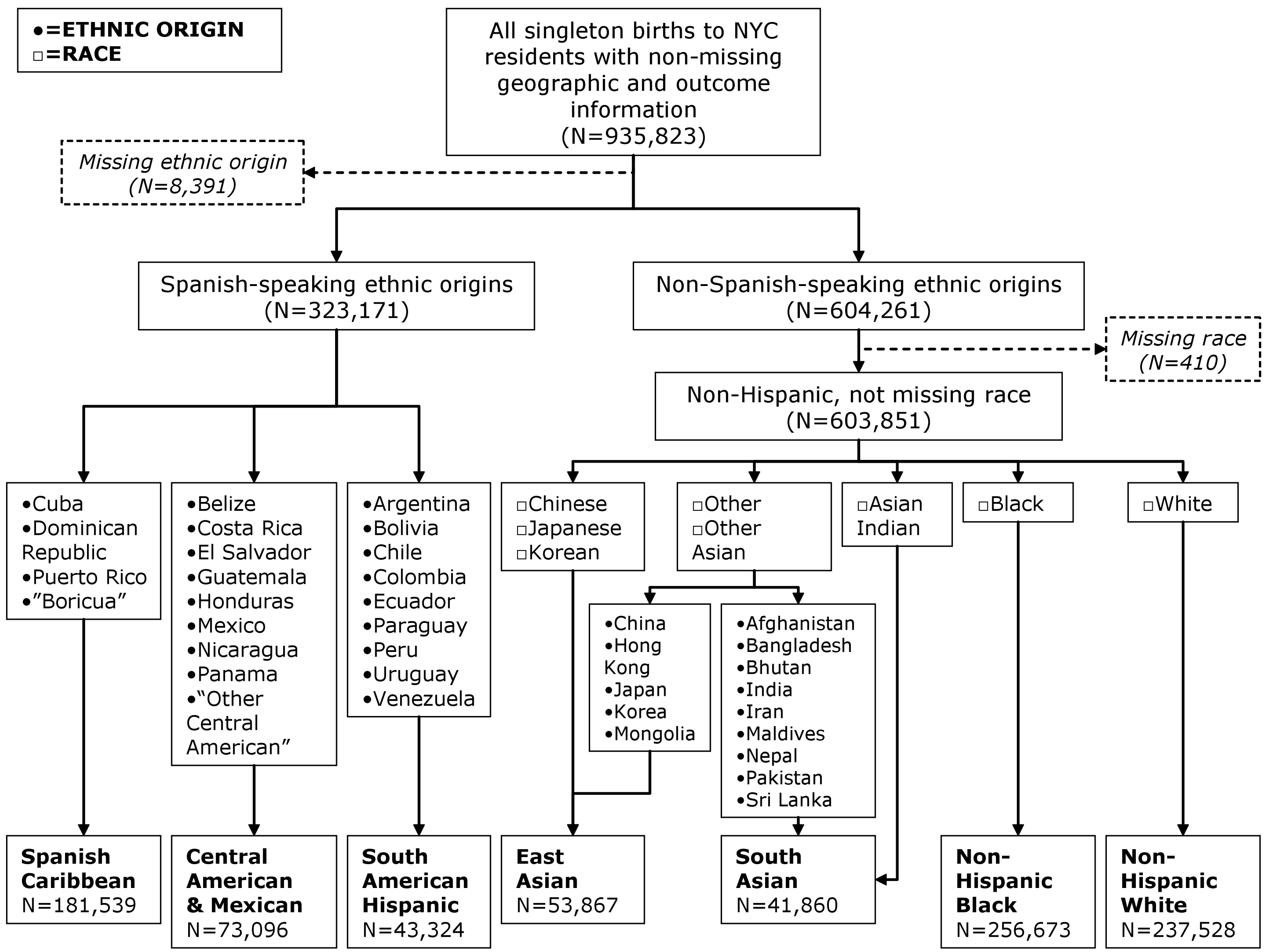


Table 3.2 Countries of birth included in African- and Caribbean-born categories of non-Hispanic black immigrants. There were 4,845 births to non-Hispanic black immigrants who did not originate in Africa or the Caribbean.

AFRICAN BIRTH COUNTRIES (N=21,088)		CARIBBEAN BIRTH COUNTRIES (N=87,026)
Algeria	Malawi	Anguilla
Angola	Mali	Antigua and Barbuda
Benin	Mauritania	Aruba
Botswana	Mauritius	Bahamas
Burundi	Morocco	Barbados
Burkina Faso	Mozambique	Bonaire
Cameroon	Namibia	Cayman Islands
Cape Verde Islands	Niger	Curacao
Central African Republic	Nigeria	Dominica
Chad	Rwanda	French Guiana
Comoro Islands	Sao Tome and Principe	Grenada
Congo (or Zaire)	Senegal	Guadalupe
Cote d'Ivoire (or Ivory Coast)	Seychelles	Guyana
	Sierra Leone	Haiti
Djiboute	Somalia	Jamaica
Egypt	South Africa	Martinique
Equitorial Guinea	Sudan	Montserrat
Eritrea	Swaziland	Nevis
Ethiopia	Tanzania	St. Bartholemy
Gabon	Togo	St. Kitts
Gambia	Tunisia	St. Lucia
Ghana	Uganda	St. Maartin
Guinea	Zambia	St. Martin
Kenya	Zimbabwe (or Rhodesia)	St. Vincent and Grenada
Lesotho	"Other African"	Suriname
Libya		Tortola
Liberia		Trinidad
Madagascar		Turks and Caicos
		"Virgin Islands"
		"West Indies"

3.3.4 Covariates

Maternal age, education, parity, prepregnancy weight, tobacco use during pregnancy, prenatal care timing, and source of payment for care were treated as potential confounders because they are associated with preterm birth, vary by ethnicity, and/or were considered to be influenced by, or markers of, maternal socioeconomic position (Figure 3.2). Nativity (US- or foreign-born) was also available in the birth records and considered a potential confounder because it is associated with birth outcomes and may influence the choice of neighborhood. Maternal marital status has been found in some studies to predict preterm birth, but this information is not gathered on the New York City birth record. Neighborhood-level covariates, from the census, included an index of neighborhood deprivation and a measure of residential stability. The coding of covariates is discussed in detail below.

Maternal age at last birthday was coded as a continuous variable (in years) in the original dataset, and was recoded for analyses as a three-level categorical variable. Two indicators for <20 years and 35+ years of age were included in the models, with 20-34 years as the referent.

The birth records included maternal education as a continuous variable by years of education completed, with a collapsed category for 17 years or more. Education was categorized into three levels: <12, 12, and 13-15 and 16+ years of education. In order to account for women who were too young to have completed high school, the <12 years category was divided into <12 years/age <20, and <12 years/age 20+. The education categories were coded as indicator variables and included in the model with 12 years as the referent.

Foreign-born women from a variety of ethnic groups have better birth outcomes than their US-born counterparts (5, 18-22). Foreign-born women may, in addition, be more likely to live in ethnically dense neighborhoods, especially those with other immigrants. An indicator for maternal foreign birth was included in the models.

The New York City birth records included a variable for the number of live births a woman has had, including the index birth. Parity was categorized into three levels: parity 1 (primiparous), parity 2-5 (multiparous), and parity 6+ (grand multiparous) and included as indicator variables with multiparous women as the reference group.

Self-reported number of cigarettes smoked per day was provided in the original data set as a measure of tobacco use during the current pregnancy. This was recoded as a binary variable with '1' indicating any tobacco use, and '0' indicating no tobacco use.

Prepregnancy weight in pounds is provided in the birth records as a continuous variable. Weight appears to have a u-shaped relationship with preterm birth, so two indicators were included in the models: <125 pounds and >150 pounds, with 125-150 pounds as the referent.

The original data set provided the timing of the first prenatal visit in days since last menstrual period. Women were coded as having adequate prenatal care if their first prenatal visit was reported to be within 120 days of the last menstrual period; otherwise they were defined having inadequate prenatal care.

An alternative measure of prenatal care adequacy, the Adequacy of Prenatal Care Utilization (APCU) Index (150), was also considered. In addition to taking into account the timing of prenatal care, the APCU Index compares the number of prenatal visits received at each gestational age with an expected number of visits. However, the number of prenatal visits documented in the New York City birth records included any health-related visit that occurred in pregnancy (including emergency room visits), so women with conditions precipitating preterm birth (e.g., threatened preterm labor) or those in ill health more generally would likely acquire additional visits. Since pregnancy complications, such as those that would lead to extra health care visits during pregnancy, are likely to be on the causal pathway from more distal neighborhood exposures to preterm birth, it was considered more appropriate to control only for the timing of prenatal care.

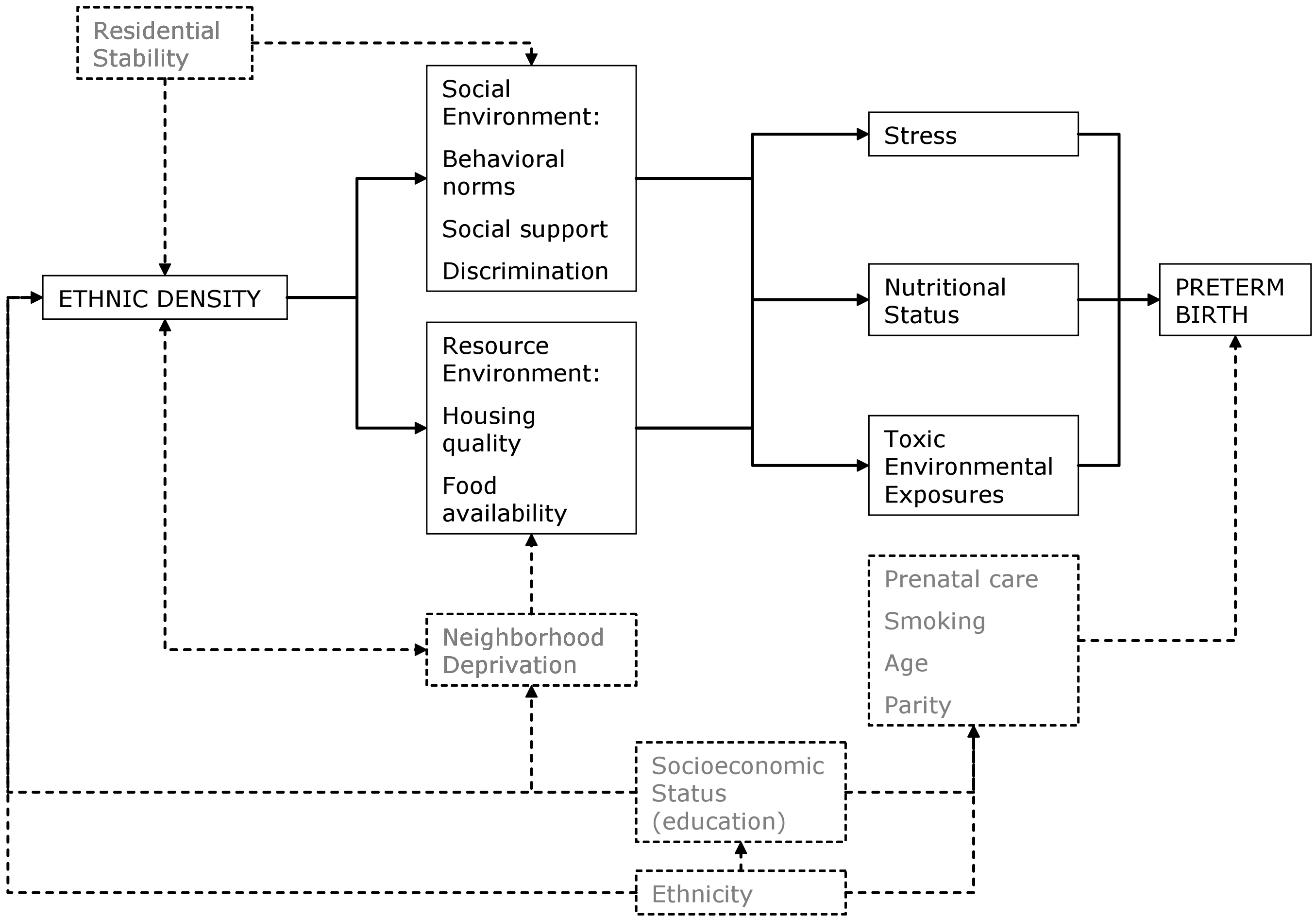
Because income information is not available on the birth records, the method of payment (three indicators representing private insurance, Medicaid, and self-pay) was used, in addition to maternal education, as an indicator of socioeconomic position.

A neighborhood deprivation index (NDI) was created from the following 17 census variables: percent of the population with less than a high-school education, percent unemployed, percent males not in work force, percent crowding, percent renter-occupied units, percent male professionals, percent female professionals, percent males in management, percent females in management, percent poverty, percent female-headed household with children, percent households with <$30,000/year, percent households on public assistance, percent households with no vehicle, median household income, median income of individuals with earnings, and median value of owner-occupied units. The variables were summarized using principle components analysis as described by Messer et al. (151), which allowed multiple highly correlated dimensions of neighborhood deprivation to be taken into account without causing multicollinearity problems in modeling.

The individual census variables contributing to the NDI were proximity-weighted in the identical manner to the exposure variable, except that median variables were additionally weighted by the total census population so that the most populous census tracts would have greatest influence on the final computed medians. (For percentage variables, the denominator served this purpose.) The NDI was dichotomized at the overall (full sample rather than ethnic-specific) median.

Ethnic heterogeneity in a neighborhood may reflect a transition from one kind of ethnic enclave to another (61). Residential disruption may thus precipitate ethnic heterogeneity, and also influences the social environment. Therefore, residential stability (operationalized as the percent of individuals who resided in the same house between 1995 and 2000) was considered a potential confounder of the relationship between neighborhood ethnic composition and preterm birth. Like the NDI, residential stability was proximity-weighted and dichotomized at the overall median.

Figure 3.2 Causal model showing hypothesized links between ethnic density and preterm birth along with covariates. Solid lines indicate primary pathways of interest, while dashed lines indicate secondary pathways involving covariates.



3.4 Data Analysis

The distribution of births across exposure and covariate strata was examined, along with the proportion of births in each stratum that were preterm. Aggregated outcome and exposure data were uploaded into ArcMap (ESRI) and assigned as attributes of New York City census tracts in order to map the spatial patterning of study variables.

The ethnic density-preterm birth association was modeled initially using multi-level (random intercept) logistic regression with census tracts as the cluster variable; these models provide within-tract estimates of the exposure-outcome association (152, 153). However, the estimated intra-cluster correlation coefficients from these models were small, and marginal models provided nearly identical results in a fraction of the processing time. In addition, recent publications have argued that marginal estimates may be more public health-relevant than within-cluster estimates (154) because they estimate an effect for the entire population rather than for one specific census tract. Marginal models with the Huber-White “sandwich” variance estimator, employed to account for clustering at the census tract level (155), were therefore chosen over random intercept models for all analyses.

Each aim investigated unique ethnic density exposures within specific ethnic or immigrant strata. The modeling strategies for each aim are presented below.

3.4.1 Analyses for Aim 1

Aim 1 examined the preterm birth risk in seven ethnic groups associated to "own-group" density. Separate sets of models were run for non-Hispanic white, non-Hispanic black, Spanish Caribbean, Central American (and Mexican), South American Hispanic, East Asian, and South Asian women.

For non-Hispanic white and black mothers, respectively, non-Hispanic white and black densities served as the exposures. For Spanish Caribbean, Central American, and South American mothers, the exposure was defined as the neighborhood density of Hispanics, and for East and South Asian mothers the exposure was defined as Asian density. While region-specific ethnic densities (e.g. density of Central Americans) were available from the census data, and were theoretically preferable, they included a large amount of missing data due to small-population data suppression (156). Using the broader ethnic groups avoided the issue of data suppression while providing a reasonable representation of neighborhood-level segregation. Supplemental models using region-specific ethnic densities were also run, although interpretation of the results is limited by the high levels of missingness.

Ethnic density was dichotomized at 25%, which allowed for adequate observations in exposed and unexposed groups across all ethnic categories. Results using a 20% dichotomization were also examined to ensure that findings at a particular cut-point were not driven by random variability.

The following modeling strategy was employed for all seven ethnic groups. First, the log odds of preterm birth was modeled as a function of ethnic density alone to estimate the crude exposure-outcome association. Second, models were adjusted for all covariates. Third, adjusted models were re-run without the two most frequently missing covariates: prenatal care and prepregnancy weight. Around 20% of observations were missing one or more of these variables. A change-in-estimate analysis was conducted to assess the extent of confounding incurred by their exclusion; a change in the odds ratio of less than 10% was considered minimal enough to prefer the increase in precision and generalizability gained by omitting these variables (157). Fourth, neighborhood deprivation-stratified models were run, since the psychosocial correlates of segregation may have a different association with preterm birth depending on the resource environment that is also present.

Finally, crude, adjusted, and stratified risk differences (RDs) were computed from the logistic model regression coefficients for US-born women aged 20-34 who were high-school educated, had 2-5 previous live births, received early prenatal care, were on Medicaid, and resided in a more stable and poorer neighborhood. Risk differences provide an estimate of the number of preterm births attributable to (or prevented by) residence in ethnic enclaves (assuming the modeled associations are valid and causal), and are therefore particularly informative for public health and policy applications.

3.4.2 Analyses for Aim 2

Aim 2 focused on the variation in preterm birth risk among non-Hispanic black women related to whether they share their neighborhood with non-Hispanic whites, Hispanics, Asians, or other non-Hispanic blacks.

Crude estimates of the relationship between Hispanic, Asian, non-Hispanic white, and non-Hispanic black neighborhood densities and non-Hispanic black preterm birth risk were obtained by regressing the log odds of preterm birth among non-Hispanic black women on Hispanic, Asian, white, and black ethnic densities in four separate models. The ethnic densities were represented by continuous variables, because visual inspection indicated that log odds of non-Hispanic black preterm birth decreased in a roughly linear fashion with Asian and white density, and increased roughly linearly with Hispanic density. A squared black density term was included in the black density model, since black density appeared to have a curvilinear and positive relationship with log odds of PTB.

The subsequent modeling strategy was designed to estimate the way that preterm birth risk among non-Hispanic black women changes as 1) a neighborhood becomes more Hispanic and less white, controlling for non-Hispanic black and Asian densities, 2) a neighborhood becomes more Asian and less white, controlling for black and Hispanic densities, and 3) a neighborhood becomes more black and less white, controlling for Hispanic and Asian densities.

First, an adjusted model was run that included Hispanic, Asian, and black density variables, along with covariates. Non-Hispanic white density was excluded from the model to serve as the referent, so that those "unexposed" to Hispanics, Asians, or non-Hispanic blacks were those living in white neighborhoods. The model coefficients may, in other words, be interpreted as the change in log odds of non-Hispanic black preterm birth corresponding to the replacement of white neighbors with Hispanic, Asian, or black neighbors.

After running the fully adjusted model, a reduced model was run without the two most frequently missing covariates: pre-pregnancy weight and early prenatal care. Almost 18% of records were missing data on one or both of these variables. A change-in-estimate analysis was conducted to assess the extent of confounding incurred by their exclusion; a change in the odds ratio of less than 10% was considered sufficiently minimal to prefer the increase in precision and generalizability gained by omitting these variables (157).

Two variables were considered as potential effect measure modifiers: neighborhood deprivation and maternal nativity (US- or foreign-born). The psychosocial correlates of segregation may have a different association with preterm birth depending on the resource environment that is also present. Similarly, immigrants' perceptions of their neighborhood and neighbors may differ from that of their American-born counterparts. For example, Hispanic neighborhoods may be more protective of black immigrants, who are less likely than their US-born counterparts to have already adopted American norms around diet or other behaviors.

Finally, crude, adjusted, and stratified risk differences (RDs) were computed from the logistic regression model coefficients. Risk differences provide an estimate of the number of preterm births attributable to (or prevented by) residence in ethnically dense areas (assuming the modeled associations are valid and causal), and are therefore particularly informative for public health and policy applications.

Differences in preterm birth risk were calculated for a change from the 10th to the 90th percentile of Hispanic, Asian, and non-Hispanic black neighborhood density experienced by non-Hispanic black women. For Hispanic ethnic density, the 10th percentile corresponded to 5.2% Hispanic and the 90th percentile corresponded to 61.9% Hispanic; that is, 10 percent of births to non-Hispanic black women occurred in neighborhoods that were between 0% and 5.2% Hispanic while 90% occurred in neighborhoods that were between 0% and 61.9% Hispanic. Black births tended to occur in less densely Asian than Hispanic neighborhoods, indicating less overlap between black and Asian populations; the 10th and 90th Asian density percentiles corresponded to neighborhoods that were 0.3% and 8.1% Asian, respectively. The 10th and 90th percentiles of non-Hispanic black density corresponded to tracts that were 17.8% and 88.9% black, and the 10th and 90th percentiles of non-Hispanic white density were 0.6% and 23.6% white, respectively. The RDs were computed for US-born women aged 20-34 who were high-school educated, had 2-5 previous live births, were on Medicaid, and resided in a more stable, poorer, and white neighborhood. Stratified risk differences were presented only if estimates differed by more than 5 PTBs per thousand births across strata.

3.4.3 Analyses for Aim 3

Aim 3 focused on non-Hispanic black immigrants, examining the neighborhood density of African and Caribbean blacks in relation to the risk of preterm birth among African- and Caribbean-born non-Hispanic black women, respectively. As a comparison, the US-born non-Hispanic black density was also investigated as a predictor of the risk of preterm birth among US-born non-Hispanic black women.

Three sets of logistic models were run, one each for African-, Caribbean-, and US-born non-Hispanic black women. To make the results more directly relevant for public health and policy application, the logistic regression model coefficients were used to compute risk differences (RDs). Risk differences provide an estimate of the number of preterm births attributable to (or prevented by) the exposure (assuming the modeled associations are valid and causal).

The following modeling strategy was common to all three groups and was designed to estimate the ways that preterm birth risk changes as a woman is increasingly exposed to others with her ethnic and immigrant identity. First, crude estimates were obtained by regression of the log odds of preterm birth among African-, Caribbean-, and US-born non-

Hispanic black women on continuous African, Caribbean, and US-born black densities, respectively. A visual inspection indicated a roughly linear increasing relationship between log odds of preterm birth and own-group ethnic/immigrant density for Africans and Caribbeans. In contrast, the preterm birth—ethnic density relationship among US-born black women appeared to be curvilinear, with log odds of PTB increasing more dramatically at the lower end of the density range and flattening out at the top; a squared term was therefore included in the US-born black models.

Second, adjusted estimates were obtained from the three models run with all individual- and contextual-level covariates. Third, reduced models were run without the two most frequently missing covariates: pre-pregnancy weight and early prenatal care. Around 14% of births to Caribbean women and 18% births to African and US-born black women were missing data on one or both of these variables. A change-in-estimate analysis was conducted to assess the extent of confounding incurred by their exclusion; omission of these variables was considered worthwhile for the gain in precision and generalizability if it changed the risk difference by less than 2 PTBs per thousand births.

Fourth, neighborhood deprivation was investigated as a potential effect measure modifier, because the association between preterm birth and the psychosocial correlates of segregation depend on the resource environment that is also present. Stratified risk differences were presented only if estimates for at least one of the groups differed by more than 5 PTBs per thousand births across strata.

Differences in preterm birth risk were calculated for a change from the 10th to the 90th percentiles of ethnic density for each group. The 10th percentile of African density experienced by black African immigrants in the birth records corresponded to 0.2% African, while the 90th percentile corresponded to 7.0% African; that is, 10 percent of black African births occurred to women residing in neighborhoods that were between 0% and 0.2% African and 90% occurred to women residing in neighborhoods that were between 0% and 7.0% African. The 10th and 90th percentiles for Caribbean density were 2.3% and 39.5%, respectively, while for US-born blacks they were 13.0% and 70.1%, respectively. The RDs were computed for US-born women aged 20-34 who were high school-educated, had 2-5 previous live births, received early prenatal care, were on Medicaid, and resided in a more stable and poorer neighborhood.

3.4.4 Supplemental Analyses

Adjusted models for all aims were re-run among primiparous women to remove any influence of repeat births to the same woman over the study period, because repeat births could not be linked to the same woman in the birth records. Adjusted models were also re-run with medically-indicated preterm births, identified using linked hospital discharge data, excluded from the analysis in order to obtain an estimate specific to spontaneous preterm birth.

CHAPTER 4

ETHNIC DENSITY AND PRETERM BIRTH ACROSS SEVEN ETHNIC GROUPS IN NEW YORK CITY

4.1 ABSTRACT

Background: Residential segregation in the United States separates non-white ethnic groups from resources and opportunities available to whites, but there may also be positive correlates of segregated neighborhoods such as reduced exposure to discrimination. Among Hispanics and Asians, ethnic density may buffer the stress of acculturation or provide access to country-of-origin foods. This analysis examined preterm birth risk in ethnically dense (>25% ethnic group) neighborhoods across seven ethnic groups in New York City.

Methods: New York City birth records for 1995 through 2003 provided outcome and individual covariate data; a spatial measure of ethnic density was computed from 2000 Census data. Log odds of preterm birth to non-Hispanic whites, non-Hispanic blacks, three Hispanic groups (Spanish Caribbeans, Central Americans, and South Americans), and two Asian groups (East Asians and South Asians) were modeled as a function of the density of non-Hispanic whites, non-Hispanic blacks, Hispanics, and Asians, respectively. Models used the Huber-White variance to account for clustering, and ethnic densities were dichotomized at 25%. Logistic model coefficients were used to compute risk differences.

Results: Covariate-adjusted differences in preterm birth risk comparing >25% ethnic density to lower-density neighborhoods ranged from 15.0 per thousand (-18.5, -11.4) among whites and 6.4 per thousand (95% CI: 2.8, 9.9) among blacks. Hispanic and Asian responses to ethnic density were less pronounced, but tended to be protective. When estimated in poorer neighborhoods, the protective effect was stronger for all groups except non-Hispanic blacks.

Conclusions: Ethnic density most clearly advantages non-Hispanic whites and harms non-Hispanic blacks, which may result from uneven resource distribution perpetuated by segregation or reflect perceived social positions related to residence in black and white neighborhoods. Non-Hispanic blacks appear to be uniquely harmed by ethnic density.

4.2 Background

Racial and ethnic residential segregation is a deeply entrenched and widespread aspect of the social geography of the United States (55, 58, 61), with some areas so segregated that they have been compared to apartheid-era South Africa (69). Segregation in the United States (US) has traditionally limited the opportunities and resources available to non-white populations (53, 66, 67), either by design, as in the Jim Crow South where white legislators used segregationist policies to exclude black populations from full civic engagement and employment opportunities, or through the translation of lower individual incomes into community-wide disadvantage (66, 69).

Social and health science research has focused primarily on segregation of blacks from whites, documenting links between segregation and a variety of social and physical ills in the black population (79-82, 85-88, 91-98, 101-105, 109, 158, 159). From a perspective that privileges material resources as the means to health (160), this is entirely unsurprising, given the historical discrimination of blacks in employment and education that is facilitated by segregation, as well as chronic under-investment in black neighborhoods. From a psycho-social standpoint (73), however, residence in black neighborhoods might have the benefits of limiting negative inter-racial interactions, facilitating social networks, and/or providing a context for political organizing (70-72, 74). Indeed, a handful of studies have found black residents of black neighborhoods to have better birth outcomes (31, 114) and lower mortality (110, 111) than those in heterogeneous neighborhoods.

Among less-studied groups such as Hispanic and Asian immigrants, for whom segregation may arise in large part from patterns of chain migration (and may be less representative of historical exclusion and oppression), segregation may be less detrimental, on net, than it is among black Americans (80, 116-119, 121, 122, 125, 126, 161). Segregated neighborhoods may, in addition, provide unique protections to recently-arrived ethnic groups by buffering the stress of acculturation and providing access to country-of-origin foods (65, 75), although the number of segregation studies focusing on these groups is limited.

Residential segregation is a spatial phenomenon, and one of the frequently cited weaknesses of segregation research is its reliance on measures that are considered to be "aspatial" (139). Segregation measures represent either the composition of individuals within neighborhoods (for neighborhood-level comparisons), or the distribution of individuals across neighborhoods (for city- or region-level comparisons). Segregation measures that use administrative units (e.g. census tracts) to define neighborhoods without taking into account the arrangement of the units in space (so-called "aspatial measures") may mis-characterize the level of segregation of an area (51) if the chosen administrative is not appropriate. If, for example, the boundaries chosen are too large, the measure will miss finer-scale segregation, so that a patchwork of highly segregated small black and white neighborhoods will be lumped together and viewed as a heterogeneous or "integrated" whole. Aspatial measures additionally assume that all areas outside the neighborhood boundary are irrelevant to the experience of those residing within; that is, the measures don't take into account any of the surrounding area (51, 138). Thus, aspatial measures cannot distinguish between the segregation experience of those living in a black neighborhood within a mixed-race area from that of individuals living in a large black ghetto.

The aim of this analysis is to increase understanding of the segregation-health relationship by examining preterm birth risk in "ethnic enclaves" (ethnically dense areas) across multiple, often understudied, ethnic groups. Preterm birth, or birth before the 37th week of gestation, is an outcome of particular public health relevance because it is an important cause of infant mortality, leads to a variety of morbidities and learning impairments in children and adults, and is the largest contributor to the two-fold black-white disparity in infant death (1, 6, 7). The etiology of preterm birth remains vague, although, like many health outcomes, it is linked to smoking, poor nutrition, and both individual- and contextual-level poverty (1). Mounting evidence suggests that stress may play a particularly important role, either by triggering hormones related to labor initiation or through an inflammatory pathway provoked by immune suppression and infection (29, 35-38). Several studies have documented a correlation between preterm birth and a variety of stressful life experiences (including racial discrimination) (42-45), self-reported stress (41), and stressful neighborhood environments (27). These studies suggest that preterm birth is likely to be sensitive to the material and psychosocial correlates of segregation.

Using New York City birth records, this analysis focuses on risks of preterm birth among non-Hispanic white, non-Hispanic black, Spanish Caribbean, Central American (plus Mexican), South American Hispanic, East Asian, and South Asian mothers. To avoid the limitations of non-spatial segregation measures, the ethnic composition of each mother's neighborhood was represented by a spatial measure, "proximity-weighted ethnic density" (138, 162), which characterizes each mother's segregation experience based not only on the ethnic composition of her immediate geographic location but also incorporates information about the surrounding area.

4.3 Methods

4.3.1 Data Sources and Management

New York City birth records from January 1, 1995 through December 31, 2003 provided outcome (gestational age), ethnicity, and individual-level covariate data on all births occurring in the study area over the nine-year period (N=1,084,882). The birth records were geocoded and each observation was assigned a 1990 or 2000 census tract number (depending on the year of birth) by the New York City Department of Health and Mental Hygiene. Births were excluded if they the result of multiple gestation pregnancies (N=17,526), occurred to women residing outside of New York City (N=14,780), were missing census tract or county information (N=108,433), or were assigned to non-existent (N=1,812), ambiguous (N=62), or unpopulated (N=28) census tracts. Births missing gestational age information (N=6,418) were also excluded.

Seven ethnic group categories (non-Hispanic white, non-Hispanic black, Spanish Caribbean, Central American plus Mexican, South American Hispanic, East Asian, and South Asian) were constructed from the self-reported race and ethnic origin variables available in the birth records (Figure 3.1). Births without the race or ethnic origin information necessary to create maternal ethnic group categories (N=8,801) were excluded, along with 13,923 births to women with non-Hispanic ethnic origins that were not white, black, East Asian, or South Asian and 25,212 births to women who reported a Hispanic ethnic origin not in the Spanish Caribbean, Central America, or South America (the majority of these were women who reported their ethnic origin as "Hispanic"). These exclusions left 887,887 observations for the analysis.

In order to create consistent tract numbers over the 1990 and 2000 Censuses, 1990 US Census tracts that were absorbed into another tract in the 2000 Census were assigned the 2000 tract numbers. Likewise, year 2000 tracts that were split from 1990 tracts were merged back to their "parent" tracts and assigned the 1990 tract numbers (140). After updating, there were 2,168 unique tract numbers in the birth records.

Summary File 1 from the 2000 US Census provided total and ethnic group population counts in all 2,217 tracts contained in the five counties of New York City, while area-level covariates were obtained from Summary File 3. In order to match the birth records, 30 year 2000 tracts were merged to create the 15 1990 tracts from which they were split, leaving 2,202 unique tracts in the census data. Census tracts that were not found in the birth records consisted primarily of low-population tracts and Tract 1 in the Bronx, corresponding to Riker's Island Prison.

4.3.2 Variables and Variable Construction

The outcome, preterm birth, was defined as a live singleton birth at greater than 20 but less than 37 completed weeks of gestation using the clinical estimate of gestational age (1).

The exposure, neighborhood ethnic density, was defined as the percentage of the population in a woman's area of residence with a given ethnic identity. For non-Hispanic white and black mothers, respectively, non-Hispanic white and black densities were used as the exposures. For Spanish Caribbean, Central American, and South American mothers, the exposure was defined as the neighborhood density of Hispanics, and for East and South Asian mothers the exposure was defined as Asian density. While region-specific ethnic densities (e.g. density of Central Americans) were available from the census data, and were theoretically preferable, they included a large amount of missing data due to small-population data suppression. Using the broader ethnic groups avoided the issue of data suppression while providing a reasonable representation of neighborhood-level segregation.

Following Reardon and Firebaugh (138, 162), the areas nearest a woman were assumed to contribute most to her experience of neighborhood-level ethnic density. Populations farther away were allowed to influence her estimated exposure as well, but this influence decreased in proportion to distance. Because they were the smallest unit available in the birth records, census tracts were used to locate the women geographically, and the distance from each woman's residence to other populations was estimated using the distances between approximate census tract centers (centroids). New York City census tracts are geographically small, with a mean area of 354,340 square meters (0.14 square miles) and a median of 180,403 square meters (0.07 square miles). The position of centroids was calculated using a center-of-mass generator in (142), which estimates the geographically-weighted center of each tract, and between-centroid distances were then computed in ArcGIS (ESRI).

The "proximity-weighted ethnic density" (138) (Π_{JM}) for a woman belonging to ethnic group *M* and residing in census tract *J* was calculated by multiplying the population count of ethnic group *N* in each census tract *K* (x_{KN}) by a weight (p_{JK}) that represents the proximity of tracts *J* and *K*. These weighted ethnic populations were summed and then divided by total census tract populations (x_K) that were weighted in the identical manner. This produced a weighted "percent" as shown below:

$$\Pi_{JM} = \frac{\sum_K (x_{KN} \times p_{JK})}{\sum_K (x_K \times p_{JK})}$$

The proximity weight (p_{JK}), a "biweight kernel", allows census tract *K*'s influence to decay in an approximately Gaussian manner with its distance from census tract *J* (147):

$$p_{JK} = \left(1 - \frac{(d_{JK})^2}{r}\right)^2 \text{ if } r<c\text{, else } p_{JK}=0$$

Where d_{JK} is the distance between census tracts *J* and *K*. Note that if *J*=*K*, then d_{JK} = 0 and p_{JK} = 1; that is, a census tract's own ethnic composition will have maximal influence on the estimated exposure of the residents of that census tract. The variable *r* is the distance from census tract *J* beyond which there is no influence on *J's* estimated ethnic density. The value of the radius, *c*, is chosen based on the hypothesized area thought to meaningfully affect the environment of those living in census tract *J*. Lee and colleagues suggest a radius of 500m to approximate residential areas accessible by foot (147), which was thought to be a more appropriate neighborhood definition for a densely populated urban area such as New York City than other suggested radii, which represent distances generally traveled by car. The proximity-weighted ethnic density was dichotomized at 25% for all groups, which allowed for an adequate number of births in both exposed and unexposed categories. A sensitivity analysis was also conducted with ethnic densities dichotomized at 20% to ensure that results were not driven by random variability at one cut-point.

The following covariates were included in the adjusted models: maternal age (indicators for <20, 20-34, and 35+ years, with 20-34 as the referent), education taking age into account (indicators for <12 years and <20 years of age, <12 years and 20+ years of age, 12 years, 13-15 years, and 16+ years, with 12 years as the referent), nativity (US- or foreign-born, with US-born as the referent), parity (indicators for 1, 2-5, and 6+ previous births, with 2-5 as the referent), tobacco use (smoker or nonsmoker, with nonsmoker as the referent), prepregnancy weight (indicators for <125, 125-150, and >150 pounds, with 125-150 as the referent), prenatal care received in first 120 days of gestation (yes or no, with yes as the referent), payment type (indicators for private insurance, Medicaid, or out-of-pocket, with Medicaid as the referent). In addition, residential stability (percent of the neighborhood population residing in the same house from 1995 to 2000) and neighborhood deprivation, both dichotomized at the overall median, were included as contextual-level covariates with more-stable and poorer tracts chosen as the reference groups.

Neighborhood deprivation was represented using a standardized index arising from 17 tract-level census variables (% of the population with less than a high-school education, % unemployed, % males not in work force, % crowding, % renter-occupied units, % male professionals, % female professionals, % males in management, % females in management, % poverty, % female-headed household with children, % households with <$30,000/year, % households on public assistance, % households with no car, median household income, median income of individuals with earnings, median value of owner-occupied units) that were summarized using principle components analysis as described by Messer et al (151). Principle components analysis allowed multiple highly-correlated dimensions of neighborhood deprivation to be taken into account in the model without creating problems of multicollinearity. Both residential stability and the component variables of the neighborhood deprivation index were proximity-weighted in the same manner as ethnic density.

4.3.3 Data Analysis

Logistic regression was used to model the relationship between preterm birth and dichotomized proximity-weighted ethnic density, with the Huber-White “sandwich” variance estimator employed to account for clustering at the census tract level (163, 164). The coefficients from these marginal models closely approximated the results from random-intercept models, for which the estimated intra-cluster correlation coefficients were very small (all <0.02), and therefore the marginal models were chosen over the random-effects models to reduce processing time. Several recent articles have also argued that results from marginal models are more appropriate for public health inference (154) because they estimate an average effect for the entire population rather than for the population of a single neighborhood.

The following modeling strategy was employed for all ethnic groups. First, the log odds of preterm birth was modeled as a function of ethnic density alone to estimate the crude exposure-outcome association. Second, models were adjusted for all covariates. Third, adjusted models were re-run without the two most frequently missing covariates: prenatal care and prepregnancy weight. Approximately 20% of observations were missing one or more of these variables. A change-in-estimate analysis was conducted to assess the extent of confounding incurred by their exclusion; a change in the odds ratio of less than 10% was considered sufficiently minimal to prefer the increase in precision and generalizability gained by omitting these variables (157). Third, neighborhood deprivation-stratified models were run, since the psychosocial correlates of segregation may have a different association with preterm birth depending on the resource environment that is also present. Fourth, crude, adjusted, and stratified risk differences (RDs) were computed from the logistic model regression coefficients, with US-born women aged 20-34 who were high-school educated, had 2-5 previous live births, received early prenatal care, were on Medicaid, and resided in a more stable and poorer neighborhood as the underlying risk group. Risk differences provide an estimate of the number of preterm births attributable to (or prevented by) residence in ethnic enclaves (assuming the modeled associations are valid and causal), and are therefore particularly informative for public health and policy applications.

4.4 Results

The majority of the 887,887 births included in the analysis occurred to non-Hispanic white, non-Hispanic black, or Spanish Caribbean women (Table 4.1), reflecting the ethnic distribution of the city as a whole. Non-Hispanic whites were somewhat under-represented in the births when compared to New York City residents in general, where they comprised around 35% of the population in the 2000 US Census, indicating lower fertility in this group. The proportion of births to Central Americans, South Americans, and South Asians was greater than the population of these groups as a whole, indicating higher fertility among these groups.

East Asians had the lowest risk of preterm birth of all the ethnic groups (4.6%), followed closely by non-Hispanic whites (5.3%). Non-Hispanic blacks had by far the highest risk (10.8%), two percentage-points higher than Spanish Caribbeans, the second most at-risk group (data not shown). Non-Hispanic blacks did not, however, have the least favorable distribution of covariate risk factors, as they were more likely than Spanish Caribbeans, Central Americans, and South Americans to have education beyond a high school degree, were less likely to be on Medicaid than any other group except whites, and were more likely than Spanish Caribbeans or East Asians to have early prenatal care.

The degree of ethnic density commonly experienced in the maternal neighborhood varied drastically by ethnic group, with non-Hispanic white and black births occurring largely to women residing in majority white or black neighborhoods, respectively (Figure 4.1), but with East and South Asian births occurring mostly to women in neighborhoods with only a small proportion of other Asians. The Hispanic groups fell in between, with Spanish Caribbean births more likely to occur in highly Hispanic neighborhoods than either Central or South American births. These ethnic density differences reflect the relative size of the ethnic populations, but also follow documented national and historical trends in which blacks and whites are highly segregated from one another, while Asians tend to integrate into white neighborhoods and Hispanics fall somewhere in between (54, 58, 59). The spatial patterning of these groups is shown in Figure 4.2, which illustrates the high degree of clustering by ethnic density.

Crude changes in preterm birth risk associated with maternal residence in an ethnic enclave versus a less ethnically dense neighborhood ranged from -17.0 per thousand (95% CI: -20.9, -13.1) for white women, indicating a substantial protective effect of own-group density, to 9.5 per thousand (95% CI: 6.0, 13.1) for black women, indicating increased risk associated with residence in a black neighborhood. The Hispanic and Asian group estimates fell between those for whites and blacks. Controlling for covariates moved the estimates toward the null for all groups except South Americans (Table 4.2, Figure 4.3). When adjusted, the risk difference was -15.0 per thousand (-18.5, -11.4) among whites and 6.4 per thousand (95% CI: 2.8, 9.9) among blacks.

The two most frequently missing variables – prenatal care and pre-pregnancy weight – were not included in the final adjusted models, because the change in the odds ratio resulting from their exclusion was 5% or less in all groups. Fully adjusted risk differences (computed with these three variables retained) are presented in Appendix 4A for comparison; estimates from the fully-adjusted models were farther from the null for all groups except whites and East Asians. These results should be treated with some caution, however, as they are based on analyses missing around 20% of the observations.

Changes in the risk differences across neighborhood deprivation strata exceeded 5 per thousand for non-Hispanic white, Central American, South American, and South Asian groups. Risk differences for white women in richer and poorer neighborhoods were -8.3 (95% CI -14.4, -2.2) per thousand and -20.0 (95% CI: -25.9,-14.1) per thousand, respectively. For Central Americans the risk differences per thousand were 2.1 (95% CI: -4.2, 8.5) and -9.6 (95% CI: -18.5, -0.8), for South Americans they were 3.2 (95% CI: -3.5, 9.9) and -2.8 (95% CI: -19.3, 13.6), and for South Asians they were -4.9 (95% CI: -11.9, 2.1) and -15.3 (95% CI: -32.0, 1.4) in richer and poorer neighborhoods, respectively. For almost all the groups, the RD was lower when estimated in poorer neighborhoods (Figure 4.4), but many of these estimates were quite imprecise.

Stratified models for the white, Hispanic, and Asian groups were re-run with non-Hispanic black density included, to explore the possibility that differences in estimates across neighborhood deprivation categories are driven by differences in the "out-group" ethnic composition. (For example, white women residing in non-white neighborhoods are more likely to be living with Asians if their neighborhood is wealthy and blacks if their neighborhood is poor.) Controlling for non-Hispanic black density in the models did not, however, change the overall pattern of the results, although some estimates moved slightly toward the null (Appendix 4B).

Several sensitivity analyses were conducted to assess potential changes in the results when using different population and variable specifications (Appendices 4C and 4D). First, the models were re-run with ethnic density dichotomized at 20% rather than 25%. Second, medically indicated preterm births, identified using linked hospital discharge data, were excluded from the analyses to obtain results specific to spontaneous preterm birth (spontaneous preterm labor and preterm premature rupture of membranes combined). Third, analyses were restricted to primiparous women, to remove any influence of repeat births to the same mother over the nine-year study period, which could not be identified as repeat births in the records. Fourth, models were re-run among births to mothers whose ethnic identity matched the father's ethnic identity, since the father's ethnic affiliation may influence the mother's experience of ethnic density in her neighborhood. Finally, the models were re-run among foreign-born women only. The overall pattern of findings remained largely unchanged in these analyses. For the smaller groups (e.g. South Americans) restricting to primiparous women shifted the estimates more substantially, but the level of imprecision was also increased so it was difficult to say whether this was a meaningful change. When the father's ethnic identity matched the mother's, the effect of ethnic density appeared to be less protective among white mothers but more protective among Spanish Caribbean mothers; however, paternal ethnicity information was missing for about 20% of the births, so these results should be interpreted with caution.

To assess the extent to which misclassification of gestation length influenced the results, birth weight, which is generally accurately measured, was used to classify births as very low birth weight (birth weight <1500g), a highly specific subset of preterm birth that is unlikely to be misclassified. Models re-run with very low birth weight produced results similar to the main analyses, except that ethnic density was associated with an increased risk of very low birth weight in both wealthier and poorer neighborhoods for South American Hispanics.

4.5 Discussion

Several previous studies have found increased ethnic density to have a neutral or protective relationship with the health of Hispanic or Asian ethnic groups in the US (80, 116-119, 121, 122, 125, 126, 161), while the majority of the literature focusing on non-Hispanic black Americans has documented detrimental segregation effects (78-82, 85-88, 91-98, 101-105, 109, 158). The analysis presented here provides further evidence for this pattern; in this study, residing in a black neighborhood was associated with a modest increase in black preterm births, but for all other groups (with the exception, perhaps, of South Americans) ethnic density was associated with preterm birth in a neutral or protective manner. For non-Hispanic whites, white neighborhoods were associated with a fairly substantial reduction in covariate-adjusted preterm birth risk, while the other groups exhibited either a small protective response or none at all.

Stratifying by neighborhood deprivation changed the picture slightly. When estimated within poorer neighborhoods, risk differences for all groups (with the notable exception of non-Hispanic blacks) indicated an inverse association between preterm birth and residence in an ethnic enclave, although some of the point estimates were very close to zero. Among whites and South Asians, particularly, the risk reductions in poorer neighborhoods were sizeable and much more pronounced than those in wealthier areas. Scarcity of health-promoting resources in poorer neighborhoods may increase the relative importance of psychosocial benefits arising from a shared ethnic or cultural identity. This possibility could not, however, be examined with the available data.

Unlike the other groups, non-Hispanic black mothers had an increased risk of preterm birth when they resided in ethnic enclaves, regardless of the level of neighborhood deprivation. As noted previously, chronic under-investment in black neighborhoods may make them particularly poor, in ways that are not captured by the measures of deprivation used in this study. Because segregation has been used to separate the black population from resources, black density may, in fact, be a particularly sensitive indicator of neighborhood poverty. The historical context in which black neighborhoods have often been formed could, in addition, create a sense of oppression or powerlessness in their residents.

Recent publications have highlighted the problem of investigating the independent effects of neighborhood economic and ethnic segregation

(165, 166), since these two characteristics tend to be highly correlated, and the economic environments experienced by whites and blacks often overlap very little (28). An examination of the underlying distribution of the exposure and covariates within neighborhood deprivation strata (Appendix 4E) revealed few cells with a glaring lack of data. Some uncontrolled confounding is, nevertheless, still possible due to heterogeneity within covariate categories.

This analysis employed a spatial measure of neighborhood-level segregation to address the documented limitations of "aspatial" segregation measures. The radius, 500 meters, represents a walkable distance around the residential area (147), and was chosen as a theoretically appropriate neighborhood approximation for a population-dense urban area like New York City. Examination of distances between tract centroids indicated that most tracts were within 500 meters of several other census tracts (the mean distance from a tract to its nearest neighbor was 412 meters (SD=296), and half of all tracts were within 500 meters of 3 or more other tracts), so that the estimated ethnic density would, for most areas, include information from beyond the immediate census tract.

Despite the theoretical appeal of this spatial measure, it appeared to offer little information that wasn't captured in a non-spatial measure of tract-level ethnic density (e.g. percent black in the tract), as the correlations between the spatial and non-spatial measures were greater than 0.98 for all ethnic densities. Even using a radius of 4000 meters, the correlations were above 0.80 for all groups except Asians, for whom the correlation was 0.73. The lack of information added by incorporating surrounding areas into the measure likely reflects the high degree of clustering exhibited by ethnic enclaves; global Moran's I index computed in ArcMap showed significant spatial autocorrelation of ethnically dense census tracts, ranging from 0.13 (z-score=145) for Asian density to 0.22 (z-score=240) for Hispanic density. That is, a highly dense tract is almost always surrounded by similar tracts, so broadening the area captured in the measure simply incorporated redundant information. If census tracts are appropriate approximations of neighborhood areas, then the spatial measure used here provides a reasonable estimate of the segregation experience in the maternal neighborhood. The same estimate was, however, also obtained using far less computationally intensive non-spatial measures, although whether this would be true outside of New York City is not clear, and use of the spatial measure increases confidence in the validity of the exposure classification. When exact residential addresses are available, spatial approaches may be particularly useful, as they can be used to define neighborhoods that are based on residential street networks and bounded by major highways or railroad tracks (167).

Another limitation of the segregation measure was the lack of complete census information on region-specific ethnic populations. Central American mothers may, for example, benefit more from being near other Central Americans (who might share more cultural similarities) than from being around Hispanics in general, and a region-specific measure of ethnic identity might have produced a larger estimate of the segregation-health association. Nevertheless, a visual inspection of the geographic pattern of Spanish Caribbean, Central American, and South American births suggested that there is a fair amount of segregation within Hispanic areas by region, so that Hispanic density in the Bronx may be essentially a measure of Spanish Caribbean density, while in some areas of Queens it is more likely to represent South American density. Similarly, East Asian births are quite geographically separate from South Asian births. Nonetheless, analyses were re-run with region-specific ethnic densities for comparison, dichotomized at 15% to accommodate the lower average density of regional populations (Appendices 4D and 4F). Contrary to expectations, the Central American and South Asian estimates were moved close to the null using region-specific ethnic densities; these estimates should be interpreted in light of their rate of missingness, however, which was 12.5% for Central American density and 18.4% for South Asian density. In addition, lack of variability in the neighborhood deprivation index within Central American neighborhoods prevented adequate adjustment for the economic environment associated with high ethnic density.

The results of this analysis suggest that the balance of beneficial and harmful material and psychosocial correlates of segregation may differ across ethnic groups. Segregation most clearly benefited whites and harmed blacks in this study, perhaps reflecting the long history of unequal resource distribution between blacks and whites of which segregation is a cause, consequence, and marker. The more recently-arrived groups that are largely outside this history had somewhat more limited responses. This pattern of results may be interpreted in at least two ways. First, it may be that segregation has a different, more health-relevant, meaning among whites and blacks than it does among Hispanics and Asians. Alternatively, newer immigrant groups may benefit uniquely from ethnic enclaves, and the beneficial aspects of segregation may counteract the poverty that often accompanies it. The data used for this analysis prevented investigation of these hypothesized pathways between segregation and health, but the findings provide a basis for future research to explore these possibilities in greater depth.

Table 4.1 Distributions of births in seven ethnic groups across selected covariate levels: New York City, 1995-2003

VARIABLE	ETHNIC GROUP													
	Non-Hispanic white		Non-Hispanic black		Spanish Caribbean		Central American		South American		East Asian		South Asian	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Ethnic N, % of sample	237,528	27%	256,673	29%	181,539	20%	73,096	8%	43,324	5%	53,867	6%	41,860	5%
Ethnic density														
<=25%	23,813	10%	40,657	16%	30,959	17%	18,939	26%	11,428	26%	24,573	46%	29,063	69%
>25%	213,715	90%	216,016	84%	150,580	83%	54,157	74%	31,896	74%	29,294	54%	12,797	31%
Age (years)														
<20	5,031	2%	27,714	11%	24,281	13%	8,349	11%	2,633	6%	448	1%	874	2%
20-34	170,326	72%	183,203	71%	134,588	74%	57,939	79%	31,915	74%	41,836	78%	34,619	83%
35+	62,171	26%	45,756	18%	22,670	12%	6,808	9%	8,776	20%	11,583	22%	6,367	15%
Maternal education (years)														
<12, age<20	2,702	1%	18,130	7%	18,207	10%	6,532	9%	1,663	4%	247	0%	460	1%
<12, age>=20	15,526	7%	46,091	18%	49,101	27%	36,667	51%	10,619	25%	13,274	25%	8,058	20%
12	80,302	34%	93,299	37%	58,735	33%	20,266	28%	15,968	38%	18,605	35%	15,330	38%
13-15	41,003	17%	63,635	25%	37,848	21%	5,382	8%	8,617	20%	6,395	12%	6,729	17%
16+	95,868	41%	31,678	13%	15,504	9%	2,896	4%	5,657	13%	14,345	27%	9,842	24%
Previous births														
1	114,737	48%	107,920	42%	75,767	42%	30,088	41%	19,275	44%	28,820	54%	18,849	45%
2-5	115,855	49%	144,273	56%	104,098	57%	42,538	58%	23,798	55%	25,031	46%	22,844	55%
6+	6,899	3%	4,469	2%	1,673	1%	470	1%	249	1%	16	0%	167	0%
Prepreg. weight (pounds)*														
<125	67,539	31%	44,777	19%	46,723	28%	23,256	36%	12,191	33%	33,819	67%	14,379	41%
125-150	96,342	44%	86,615	37%	69,973	41%	27,394	43%	16,953	46%	14,394	28%	14,567	41%
>150	55,268	25%	104,617	44%	51,984	31%	13,376	21%	7,914	21%	2,432	5%	6,187	18%
Tobacco use														
Nonsmoker	228,429	96%	240,397	94%	171,968	95%	72,572	100%	42,920	99%	53,477	100%	41,672	100%
Smoker	8,436	4%	14,690	6%	8,683	5%	304	0%	257	1%	241	0%	91	0%
Late or no prenatal care*														
No	184,814	88%	169,652	75%	125,985	78%	48,797	73%	29,220	76%	41,194	83%	27,976	74%
Yes	25,764	12%	56,563	25%	34,780	22%	17,781	27%	9,455	24%	8,597	17%	10,031	26%

*Variables were missing for less than 4% of observations, except prepregnancy weight (missingness ranged from 6.0% in East Asians to 16.1% in South Asians, and prenatal care (missingness ranged from 7.6% in East Asians to 11.9% in non-Hispanic blacks).

Table 4.1, continued Distributions of births in seven ethnic groups across selected covariate levels: New York City, 1995-2003

VARIABLE	ETHNIC GROUP													
	Non-Hispanic white		Non-Hispanic black		Spanish Caribbean		Central American		South American		East Asian		South Asian	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Payment for delivery														
Private insurance	170,109	72%	86,774	35%	47,773	26%	7,566	10%	11,090	26%	21,057	40%	14,996	36%
Medicaid	56,564	24%	155,211	62%	127,806	71%	62,188	86%	30,287	70%	29,655	56%	24,964	60%
Self pay	9,841	4%	9,095	4%	4,843	3%	2,826	4%	1,646	4%	2,539	5%	1,660	4%
Nativity														
US-born	163,344	69%	141,969	56%	86,101	48%	3,685	5%	4,116	10%	2,490	5%	950	2%
Foreign-born	73,300	31%	112,966	44%	94,940	52%	69,357	95%	39,183	90%	51,194	95%	40,848	98%
Residential stability														
Less stable	110,934	47%	102,521	40%	92,175	51%	48,002	66%	31,521	73%	31,797	59%	28,372	68%
More stable	126,567	53%	154,139	60%	89,359	49%	25,090	34%	11,800	27%	22,069	41%	13,486	32%
Neighborhood deprivation														
Richer	198,036	83%	93,087	36%	41,610	23%	24,552	34%	22,758	53%	32,428	60%	31,811	76%
Poorer	39,458	17%	163,559	64%	139,911	77%	48,538	66%	20,563	47%	21,437	40%	10,044	24%

Table 4.2 Difference in preterm birth risk associated with maternal residence in an ethnic enclave (per 1000 births) for seven ethnic groups in New York City, 1995-2003

ETHNIC GROUP	MODEL							
	Crude		Adjusted		Stratified: Richer Neighborhoods		Stratified: Poorer Neighborhoods	
	RD	(95% CI)	RD	(95% CI)	RD	(95% CI)	RD	(95% CI)
Non-Hispanic white	-17.0	(-20.9, -13.1)	-15.0	(-18.5,-11.4)	-8.3	(-14.4, -2.2)	-20.0	(-25.9, -14.1)
Non-Hispanic black	9.5	(6.0, 13.1)	6.4	(2.8, 9.9)	3.4	(-1.2, 8.1)	9.0	(4.0, 14.0)
Spanish Caribbean	-3.6	(-7.4, 0.2)	-3.3	(-7.4, 0.8)	-2.4	(-7.9, 3.1)	-5.4	(-10.9, 0.1)
Central American	-3.2	(-7.9, 1.5)	-3.0	(-8.5, 2.4)	2.1	(-4.2, 8.5)	-9.6	(-18.5, -0.8)
South American	1.0	(-4.1, 6.1)	2.5	(-3.7, 8.8)	3.2	(-3.5, 9.9)	-2.8	(-19.3, 13.6)
East Asian	-3.7	(-7.4,-0.1)	-4.3	(-9.1, 0.5)	-3.0	(-8.0, 2.1)	-7.2	(-16.5, 2.1)
South Asian	-9.3	(-16.0, -2.6)	-6.7	(-13.7, 0.2)	-4.9	(-11.9, 2.1)	-15.3	(-32.0, 1.4)

*RD=risk difference; adjusted and stratified RDs were calculated for US-born women aged 20-34 who were high-school educated, had had 2-5 live births, were nonsmokers, received Medicaid, and in a more stable and (for adjusted estimates) poorer neighborhood

Figure 4.1 Distribution of births in seven ethnic groups across the range of ethnic density in the maternal neighborhood: New York City, 1995-2003. (Kernel smoothed; kernel=Epanechnikov, bandwidth=0.02)

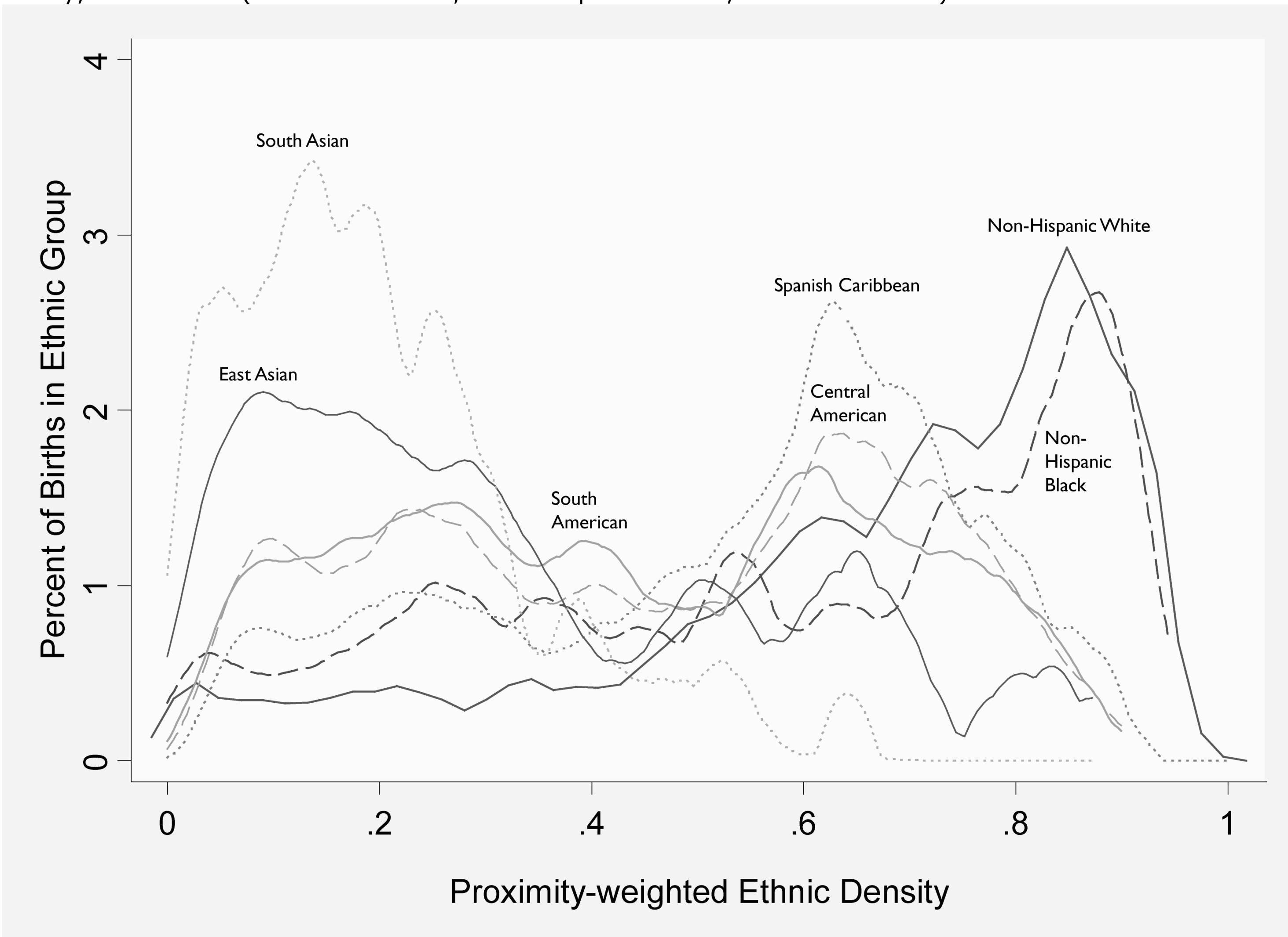


Figure 4.2 Geographic distribution, by census tract, of four ethnic densities measured with a 500-meter radius: New York City, 2000 US Census

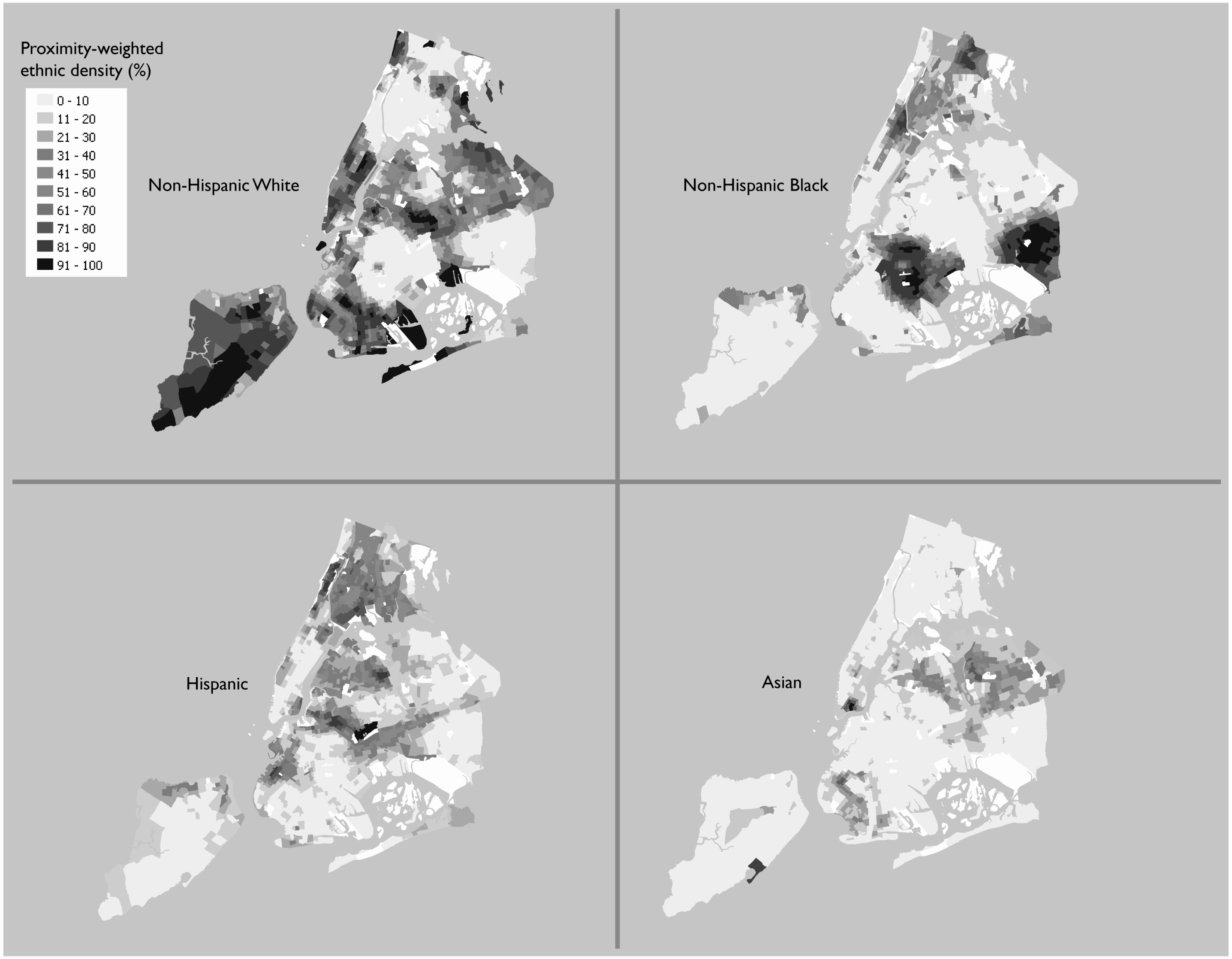
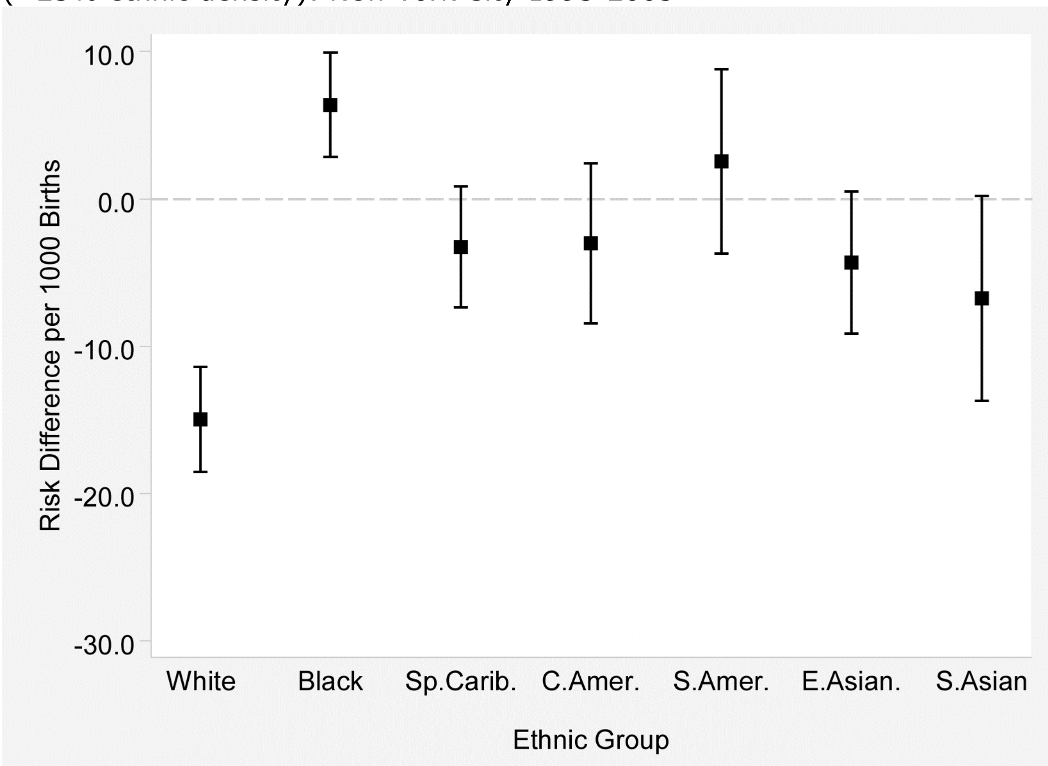


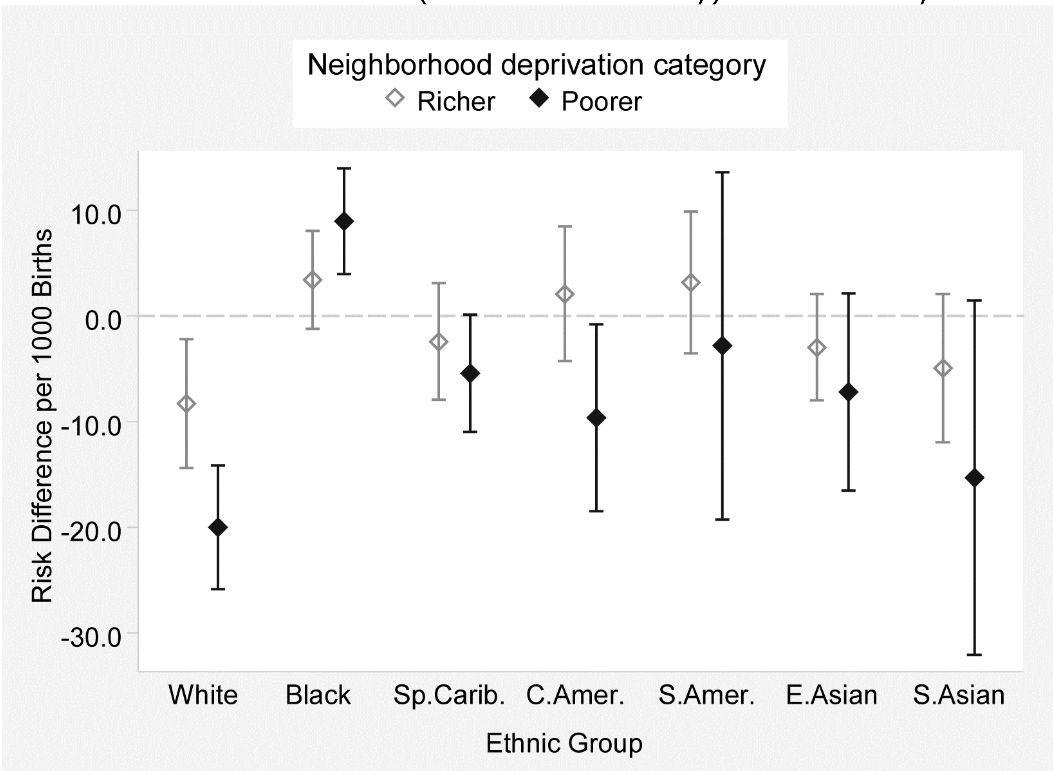
Figure 4.3 Adjusted risk differences*, with 95% confidence intervals, for preterm birth among seven ethnic groups† associated with residence in an ethnic enclave (>25% ethnic density): New York City 1995-2003



* Adjusted risk differences were calculated for US-born women aged 20-34 who were high-school educated, had had 2-5 live births, were nonsmokers, received Medicaid, and resided in a more stable and poorer neighborhood

† White=non-Hispanic white; Black=non-Hispanic black; Sp.Carib=Spanish Caribbean; C.Amer=Central American; S.Amer=South American; E.Asian=East Asian; S.Asian=South Asian

Figure 4.4 Neighborhood deprivation-stratified risk differences* with 95% confidence intervals for preterm birth among seven ethnic groups† associated with residence in an ethnic enclave (>25% ethnic density): New York City 1995-2003



* Risk differences were calculated for US-born women aged 20-34 who were high-school educated, had had 2-5 live births, were nonsmokers, received Medicaid, and resided in a more stable neighborhood

† White=non-Hispanic white; Black=non-Hispanic black; Sp.Carib=Spanish Caribbean; C.Amer=Central American; S.Amer=South American; E.Asian=East Asian; S.Asian=South Asian

CHAPTER 5

BLACK PRETERM BIRTH RISK IN NON-BLACK NEIGHBORHOODS: EXAMINING THE EFFECTS OF HISPANIC, ASIAN, AND NON-HISPANIC WHITE ETHNIC DENSITIES

5.1 Abstract

Background: Investigations of ethnic density and health have documented poorer black health outcomes in black neighborhoods when compared to non-black ones. Non-black neighborhoods are often assumed to be white, but in diverse urban settings they may also be Hispanic or Asian. Few studies have explicitly compared black health outcomes across white, Hispanic, and Asian neighborhoods. This analysis examined preterm birth risk among non-Hispanic black women related to non-Hispanic white, Hispanic, Asian, and non-Hispanic black densities.

Methods: New York City birth records from 1995 through 2003 provided outcome and individual covariate data, and a spatial measure of ethnic density was computed from 2000 Census data. Logistic regression, with the Huber-White variance to account for clustering, was used to model the relationship between preterm birth among non-Hispanic black women and continuous measures of Hispanic, Asian, and non-Hispanic black density exposures; non-Hispanic white density served as the referent exposure level. Logistic model coefficients were used to compute risk differences

corresponding to changes from the 10th to the 90th percentiles of Hispanic, Asian, and non-Hispanic black densities experienced by black women.

Results: Non-Hispanic black women residing in majority-Hispanic neighborhoods had reduced preterm birth risks when compared to women residing in majority-white neighborhoods (RD=-9.6 per 1,000 births; 95% CI: -16.6, -2.5), especially if they were foreign-born (-19.1 per 1,000 births; 95% CI: -28.6, -9.5). Estimates for Asian density were null, but were hindered by lack of overlap between Asian and black populations. Black women residing in majority-black neighborhoods experienced increases in preterm birth risk when compared to women residing in majority-white neighborhoods, but the relationship between preterm birth and black density was non-linear.

Conclusions: Foreign-born non-Hispanic black women appear to have unusually low risks of preterm birth in majority-Hispanic neighborhoods, which suggests an advantageous social environment.

5.2 Background

Racial residential segregation is a powerful means of social stratification in the United States (US). Evidence of its economic consequences for black Americans, including isolation from employment and educational opportunities (53, 68), has motivated growing interest in segregation as a cause of poor health outcomes in the black population (31, 79-82, 85-88, 91-98, 101-105, 109, 110, 112, 114, 158, 159). The majority of segregation-health studies have found racial segregation of blacks (along with black density, its neighborhood-level manifestation) to be deleterious to black health. A notable minority has, however, documented health-protective effects of residence in black neighborhoods. Theoretical explanations for both negative and positive black density effects are typically framed by comparing black neighborhoods to white ones: black neighborhoods may, for example, be health-eroding because they are under-resourced relative to white neighborhoods (168); alternatively, black density may protect black individuals from seeing themselves "through the eyes of the majority community" (73) (p.320) as members of a stigmatized group. In spite of this theoretical emphasis, few empirical results come from explicit comparisons of black and white neighborhoods; rather, most studies have compared black areas to non-black ones.

Growing diversity in US cities makes it increasingly likely that the "non-blacks" in a given neighborhood are Hispanics or Asians. Treating non-blacks as a homogeneous group (or assuming that "non-black" is synonymous with "white") is potentially problematic, as the balance of health-promoting and -eroding forces in a neighborhood may be specific to its ethnic composition. For example, while white neighborhoods are typically wealthier than black ones (169), Hispanic neighborhoods are often poorer (see Chapter 4). From a resource perspective, black residents of white neighborhoods should therefore be healthier than blacks residing in Hispanic neighborhoods, as indicated by Inagami et al. (111) who document lower age-adjusted mortality among black residents of white versus Hispanic neighborhoods in New York City.

On the other hand, Masi et al. report slightly elevated odds of preterm birth among black residents of white versus Hispanic neighborhoods in Chicago. This association is the opposite of the one expected based on material factors and might instead reflect psychosocial pathways. The strong preference expressed by whites for majority- or all-white neighborhoods (170, 171) may, for example, make white neighborhoods inhospitable to black residents, taking a toll on black health even in the face of generous material resources. Likewise, evidence of black-Hispanic solidarity (172) suggests that Hispanic neighborhoods may provide a more supportive social environment than white areas, despite their poverty. Hispanic neighborhoods are, furthermore, thought to facilitate health-positive behaviors among Hispanic residents (121), a protective milieu that might extend to members of other ethnic groups living nearby. Nonetheless, accounts of black-Hispanic (173) and black-Asian (174) hostility indicate the potential for Hispanic and Asian neighborhoods to expose black residents to both stressful social environments and neighborhood disadvantage.

This study uses geocoded New York City birth records and a spatial measure of ethnic density (138) to examine how black health outcomes differ in Hispanic and Asian neighborhoods relative to white neighborhoods. The study focuses on the health outcomes of non-Hispanic blacks, because they appear to be uniquely disadvantaged by residential segregation (168). Preterm birth (PTB), or birth before the 37^{th} week of gestation, was chosen as the outcome because it is a leading cause of infant morbidity and mortality (1), is largely responsible for the substantial disparity in infant death rates between black and white Americans (6, 7, 175), and appears to be is associated with social and contextual stressors (27, 41-45) that may arise from complex patterns of segregation.

The study seeks, specifically, to answer the following question: How does the risk of preterm birth among non-Hispanic black women change as their neighborhoods become more Hispanic or Asian and less white? Although the effect of non-Hispanic black density on non-Hispanic black preterm birth risk is not the focus of this analysis (because it has been extensively studied in this and other (31, 79-82, 85-88, 91-98, 101-105, 109, 110, 112, 114, 158, 159) populations), it is included here to allow examination of the influence of density of all four major ethnic groups, non-Hispanic black, non-Hispanic white, Hispanic, and Asian.

5.3 Methods

5.3.1 Data Sources and Management

New York City birth records from January 1, 1995 through December 31, 2003, geocoded to either 1990 or 2000 census tracts (depending on the year of birth) by the New York City Department of Health and Mental Hygiene, provided outcome (gestational age), ethnicity, and individual-level covariate data on all singleton births to women living in the study area over the nine-year period (N=1,052,576). Births to non-Hispanic black women (N=256,673) were identified from among the 935,825 (89.5%) records with complete census tract and gestational age information. Figure 3.1 provides details on the identification of non-Hispanic black mothers.

The birth records contained both 1990 and 2000 census tract numbers, with some tracts splitting between 1990 and 2000 and others merging to create one tract. Where a census tract changed across the two censuses, the larger was chosen to create consistent tract geographies over time. Specifically, 1990 tracts that were absorbed into another tract in the 2000 Census were assigned the 2000 tract numbers. Likewise, year 2000 tracts that were split from 1990 tracts were merged back to their "parent" tracts and assigned the 1990 tract numbers (140). After updating, there were 2,168 unique tract numbers in the birth records.

Summary File 1 from the 2000 US Census provided Hispanic, Asian, non-Hispanic black, non-Hispanic white, and total population counts in all 2,217 tracts contained in the five counties of New York City, which were used to compute the ethnic density exposures, while area-level covariates were obtained from Summary File 3. As in the birth records, 30 year 2000 tracts that had been split from 15 1990 tracts were merged back to their 1990 form, leaving 2,202 unique tracts in the census data. Census tracts that were not found in the birth records consisted primarily of low-population tracts and Tract 1 in the Bronx, corresponding to Riker's Island Prison.

5.3.2 Variables and Variable Construction

The outcome, preterm birth, was defined as a live singleton birth at greater than 20 but less than 37 completed weeks of gestation using the clinical estimate of gestational age (1).

The exposure, neighborhood ethnic density, was defined as the percentage of the population in a woman's area of residence self-reporting a given ethnic identity on the 2000 US Census, and was computed from the Hispanic, Asian, non-Hispanic black, non-Hispanic white, and total population counts in each census tract. Following Reardon and Firebaugh (138, 162), the areas nearest a woman were assumed to contribute most to her experience of neighborhood-level ethnic density. Populations farther away were allowed to influence her estimated exposure as well, but this influence decreased in proportion to distance. Because they were the smallest unit available, the census tract numbers provided in the birth records were used to locate the mothers geographically, and the distance from each woman's residence to other populations was estimated using the distances between approximate census tract centers (centroids). New York City census tracts are geographically small, with a mean area of 354,340 square meters (0.14 square miles) and a median of 180,403 square meters (0.07 square miles). The position of centroids was calculated using a center-of-mass generator, which computes the geographically-weighted center of each tract (142). After positioning the centroids, between-centroid distances were computed in ArcGIS (ESRI).

Using between-tract distances, the "proximity-weighted" Hispanic, Asian, non-Hispanic black, or non-Hispanic white density experienced by a non-Hispanic black woman (*M*) residing in census tract *J* (Π_{JM}) was calculated by multiplying the population count of Hispanics, Asians, non-Hispanic blacks, or non-Hispanic whites (*N*), respectively, in each census tract *K* (x_{KN}) by a weight (p_{JK}) that represents the proximity of tracts *J* and *K* (138). These weighted ethnic populations were summed and then divided by total census tract populations (x_K) that were weighted in the identical manner. This produced a weighted "percent" as shown below:

$$\Pi_{JM} = \frac{\sum_K (x_{KN} \times p_{JK})}{\sum_K (x_K \times p_{JK})}$$

The proximity weight (p_{JK}), a "biweight kernel", allows census tract *K*'s influence to decay in an approximately Gaussian manner with its distance from census tract *J* (147):

$$p_{JK} = \left(1 - \frac{(d_{JK})^2}{r}\right)^2 \text{ if } r<c\text{, else } p_{JK}=0$$

Where d_{JK} is the distance between census tracts *J* and *K*. Note that if *J*=*K*, then d_{JK} = 0 and p_{JK} = 1; that is, a census tract's own ethnic composition will have maximal influence on the estimated exposure of the residents of that census tract. The variable *r* is the distance from census tract *J* beyond which there is no influence on *J's* estimated ethnic density. The value of the radius, *c*, is chosen based on the hypothesized area thought to meaningfully affect the environment of those living in census tract *J*. Lee and colleagues suggest a radius of 500 meters to approximate residential areas accessible by foot (147), considered to be an appropriate neighborhood definition for densely populated urban areas like New York City. Other suggested radii represented distances more often traveled by car.

The following covariates were included in the adjusted models: maternal age (indicators for <20, 20-34, and 35+ years, with 20-34 as the referent), education taking age into account (indicators for <12 years and <20 years of age, <12 years and 20+ years of age, 12 years, 13-15 years, and 16+ years, with 12 years as the referent), nativity (US- or foreign-born, with US-born as the referent), parity (indicators for 1, 2-5, and 6+ previous births with 2-5 as the referent), tobacco use (smoker or nonsmoker, with nonsmoker as the referent), prepregnancy weight (indicators for <125, 125-150, and >150 pounds, with 125-150 as the referent), prenatal care received in first 120 days of gestation (yes or no, with yes as the referent), and payment type (indicators for private insurance, Medicaid, or out-of-pocket, with Medicaid as the referent). Finally, residential stability (percent of the neighborhood population residing in the same house from 1995 to 2000) and neighborhood deprivation, both dichotomized at the median, were included as contextual-level covariates with more-stable and poorer tracts chosen as the reference groups.

Neighborhood deprivation was represented using a standardized index arising from 17 tract-level census variables (% of the population with less than a high-school education, % unemployed, % males not in work force, % crowding, % renter-occupied units, % male professionals, % female professionals, % males in management, % females in management, % poverty, % female-headed household with children, % households with <$30,000/year, % households on public assistance, % households with no car, median household income, median income of individuals with earnings, median value of owner-occupied units) that were summarized using principle components analysis as described by Messer et al (151). Both residential stability and the component variables of the neighborhood deprivation index were proximity-weighted in the same manner as ethnic density.

5.3.3 Data Analysis

Logistic regression was used to model the relationship between proximity-weighted Hispanic, Asian, non-Hispanic black, and non-Hispanic white ethnic densities and non-Hispanic black preterm birth. The Huber-White "sandwich" variance estimator was employed to account for clustering at the census tract level (155). The coefficients from this adjusted marginal model closely approximated the results from the random-intercept model, for which the estimated intra-cluster correlation coefficient was very small (0.001); the marginal model was chosen over the random-effects model, as it has been argued that results from marginal models are more appropriate for public health inference (154).

Crude estimates of the relationship between Hispanic, Asian, non-Hispanic black, and non-Hispanic white neighborhood densities and non-Hispanic black preterm birth were obtained by regressing the log odds of preterm birth among non-Hispanic black women on Hispanic, Asian, black, and white ethnic densities in four separate models. The ethnic densities were represented by continuous variables, because visual inspection indicated that log odds of non-Hispanic black preterm birth was roughly linearly related to Hispanic, Asian, and non-Hispanic white densities. A squared black density term was included in the black density model, since black density appeared to have a curvilinear and positive relationship with log odds of PTB, such that black PTB increased more dramatically at the lower end of the non-Hispanic black density range and leveled out at the upper end.

The subsequent modeling strategy was designed to estimate the way that preterm birth risk among non-Hispanic black women changes as 1) a neighborhood becomes more Hispanic and less white, controlling for non-Hispanic black and Asian densities, 2) a neighborhood becomes more Asian and less white, controlling for black and Hispanic densities, and 3) a neighborhood becomes more black and less white, controlling for Hispanic and Asian densities. Specifically, an adjusted model was run that included Hispanic, Asian, and black density variables, along with covariates. Non-

Hispanic white density was excluded from the model to serve as the referent, so that those "unexposed" to Hispanics, Asians, or non-Hispanic blacks were equivalent to those living in white neighborhoods. The model coefficients may, in other words, be interpreted as the change in log odds of non-Hispanic black preterm birth corresponding to the replacement of white neighbors with Hispanic, Asian, or black neighbors.

After running the fully adjusted model, a reduced model was run without the two most frequently missing covariates: pre-pregnancy weight and early prenatal care. Almost 18% of records were missing data on one or both of these variables. A change-in-estimate analysis was conducted to assess the extent of confounding incurred by their exclusion; a change in the odds ratio of less than 10% was considered sufficiently minimal to prefer the increase in precision and generalizability gained by omitting these variables (157).

Two variables were considered as potential effect measure modifiers: neighborhood deprivation and maternal nativity (US- or foreign-born). The psychosocial correlates of segregation may have a different association with preterm birth depending on the resource environment that is also present. Similarly, immigrants' perceptions of their neighborhood and neighbors may differ from that of their American-born counterparts. For example, Hispanic neighborhoods may be more protective of black immigrants, who are less likely than their US-born counterparts to have already adopted American dietary or other norms.

Finally, crude, adjusted, and stratified risk differences (RDs) were computed from the logistic regression model coefficients. Risk differences provide an estimate of the number of preterm births attributable to (or prevented by) residence in ethnically dense areas (assuming the modeled associations are valid and causal), and are therefore particularly informative for public health and policy applications.

Differences in preterm birth risk were calculated for a change from the 10^{th} to the 90^{th} percentiles of Hispanic, Asian, non-Hispanic black, and non-Hispanic white densities experienced by non-Hispanic black women in their neighborhoods. For Hispanic ethnic density, the 10^{th} percentile corresponded to 5.2% Hispanic and the 90^{th} percentile corresponded to 61.9% Hispanic; that is, 10 percent of births to non-Hispanic black women occurred in neighborhoods that were between 0% and 5.2% Hispanic while 90% occurred in neighborhoods that were between 0% and 61.9% Hispanic. Black births tended to occur in less densely Asian than Hispanic neighborhoods, because there was less overlap between black and Asian populations; the 10^{th} and 90^{th} Asian density percentiles corresponded to neighborhoods that were 0.3% and 8.1% Asian, respectively. The 10^{th} and 90^{th} percentiles of non-Hispanic black density corresponded to tracts that were 17.8% and 88.9% black, and the 10^{th} and 90^{th} percentiles of non-Hispanic white density were 0.6% and 23.6% white, respectively.

The RDs were computed for US-born women aged 20-34 who were high-school educated, had 2-5 previous live births, received early prenatal care, were on Medicaid, and resided in a more stable, poorer, and white neighborhood. Stratified risk differences were presented only if estimates differed by more than 5 PTBs per 1,000 births across strata.

5.4 Results

On average, black births occurred to women residing in neighborhoods that were 58% non-Hispanic black (SD=27), 26% Hispanic (SD=21), 9% white (SD=15), and 3% Asian (SD=6). Despite the apparently limited overlap between black and Asian residential areas, there were over 1,000 births to non-Hispanic black women residing in neighborhoods with populations that were more than 40% Asian. In other words, the size and diversity of the New York City population provided the opportunity to explore relatively uncommon residential patterns. Figure 5.1a indicates that non-Hispanic black births in densely Hispanic neighborhoods most frequently occurred to women residing in the Bronx, while Figure 5.1b shows that black births in Asian neighborhoods tended to be clustered in Queens. Figure 5.1c shows the overlap of black births with black population density.

The majority of births to non-Hispanic black women in New York City over the nine-year study period occurred to women who were aged 20-34, had a high-school or some college education, were multiparous, reported being nonsmokers, received early prenatal care, and were on Medicaid (Table 5.1). Overall, non-Hispanic black women residing in highly Hispanic neighborhoods had less favorable risk profiles than those residing in neighborhoods with greater proportions of Asians, whites, or blacks

(Appendix 5A). Non-Hispanic black women in Hispanic neighborhoods were less likely to be high school- or college-educated than those in whiter, more Asian, or more black areas, and they were more likely to receive late prenatal care, to be on Medicaid, and to report smoking during pregnancy. Hispanic neighborhoods were also much more likely to be poor than neighborhoods with higher proportions of white, black, or Asian residents. Black women in more Hispanic neighborhoods were, however, likely to be foreign-born, and being foreign-born conferred a greater protective advantage to non-Hispanic black women in highly Hispanic areas than it did in other neighborhoods. The risk profiles of non-Hispanic black women were similar across highly Asian, non-Hispanic white, and non-Hispanic black neighborhoods, except that black neighborhoods tended to be poorer than white or Asian ones, and black women in Asian neighborhoods were more likely to be foreign-born.

Crude results suggested that non-Hispanic women residing in more densely Asian and white neighborhoods had reduced risks of preterm birth risk, while non-Hispanic black women living in more densely Hispanic and black neighborhoods were at increased risk (Table 5.2). Neighborhoods in the 90^{th} percentiles of Asian and white density had around 5.5 fewer PTBs per 1,000 births than neighborhoods in the 10^{th} percentiles. In contrast, non-Hispanic black women residing in neighborhoods in the 90^{th} percentile of Hispanic density had 2.4 more PTBs per 1,000 births (95% CI: -1.6, 6.3) compared with 10^{th} percentile neighborhoods. A change from 17.8% to

88.9% non-Hispanic black (10^{th} to 90^{th} percentiles) was associated with an increase of 5.0 PTBs per 1,000 births (95% CI: 1.4, 8.6).

Adjustment changed the overall picture substantially (Figure 5.2 and Table 5.2). Controlling for black and Asian density, Hispanic density appeared to be protective, relative to white density, of non-Hispanic black birth outcomes: the estimated preterm birth risk was reduced by -9.6 per 1,000 births (95% CI: -16.6, -2.5) in a neighborhood that was 62% Hispanic (and 38% white) when compared to a neighborhood that was 5% Hispanic (and 95% white). In contrast, increases from the 10^{th} to the 90^{th} percentiles of Asian and black densities were associated with no change in preterm birth risk (RD -0.6 per 1,000; 95% CI: -3.0, 1.7 for Asian density; RD -0.8 per 1,000, 95% CI: -8.4, 6.8 for black density).

The large change from the crude to the adjusted estimated effects of Hispanic density appears to be due largely to the inclusion of neighborhood deprivation as a control variable; neighborhood deprivation is associated with increased risks of preterm birth, and Hispanic neighborhoods are likely to be poor, so crude estimates showing higher preterm birth risk in Hispanic neighborhoods appear to be driven by the correlation between Hispanic density and neighborhood deprivation.

The null RD value associated with an increase in non-Hispanic black density reflects, in part, the curvilinear relationship between black density and black preterm birth, such that one observes larger risk differences at the lower end of the black density range. A change from the 5^{th} to 25^{th} percentiles (8.4% to 35.4% black) was associated with an increase in preterm risk of 5.4 per 1,000 (95% CI: 1.1, 9.7), in line with previous findings (Chapter 4). Because of the degree of difference in the RD values over the range of non-Hispanic black densities, RDs corresponding to both 10th to 90th and 5th to 25th percentile increases are included in Table 5.2 and in results of supplemental analyses.

The lack of association between Asian density and PTB risk among non-Hispanic blacks may be a result of the low proportion of Asians represented by 90th percentile neighborhoods; the 90th percentile of Asian density experienced by black mothers in the dataset corresponded to neighborhoods that were only 8% Asian, and it is not clear that 8% is a high enough proportion to meaningfully influence the neighborhood experience. Therefore, a risk difference was also calculated for a change in Asian density from 0% to 40%, as this is more likely to represent a meaningful change; the risk difference (-3.1 per 1,000, 95% CI: -14.9, 8.7) indicated a slightly protective effect of Asian density, but the estimate was very imprecise.

The two most frequently missing variables – prenatal care and pre-pregnancy weight – were not included in the final models, because the change in the odds ratio resulting from their exclusion was less than 10% for all estimates. Fully adjusted risk differences (computed with these two variables retained) are presented in Appendix 5B for comparison; estimates from the fully-adjusted models were closer to the null, but should be treated with some caution as they are based on analyses missing nearly 20% of the observations.

Examination of neighborhood deprivation as a potential modifier of the ethnic density–preterm birth relationship was hindered by a lack of overlap in the ethnic density ranges across neighborhood deprivation strata, as observed in other populations (176). Risk differences associated with both Asian and Hispanic densities had wide confidence intervals and were null in both deprivation categories, which is inconsistent with the deprivation-adjusted estimate showing a protective effect of Hispanic density, and which indicated that these estimates are unstable. This instability appears to arise in part from adjustment for non-Hispanic black density; non-Hispanic black women residing in poorer neighborhoods live almost exclusively in Hispanic or black neighborhoods, leading to Hispanic and black density collinearity in the poorer-neighborhood models. Removing black density from the models stabilized the estimates, which provided evidence for modification: in wealthier areas the risk of preterm birth increased with high Hispanic density (3.8 per 1,000; 95% CI: -5.5, 13.0) while in poorer neighborhoods Hispanic density was associated with reduced PTB risk (RD=-11.6 per 1,000; 95% CI: -16.0, -7.1). A similar modification pattern (i.e. protective ethnic density effects exclusive to poorer neighborhoods) has been found in other populations (Chapter 4). However, removing black density from the models includes black neighborhoods in the reference group, making it difficult to compare these results to estimates from the main analyses for which the referent was white neighborhoods. Estimates stratified by neighborhood deprivation were therefore not presented in the main results.

Stratification by nativity was more straightforward and suggested that the association between Hispanic density and black PTB differed substantially depending on whether the mother was US- or foreign-born (Table 5.2, Figure 5.2). An increase in Hispanic density was associated with very little change in preterm birth risk (RD -2.4 per 1,000; 95% CI: -11.6, 6.8) among US-born non-Hispanic black women, while among foreign-born non-Hispanic black women there was a decrease in preterm birth risk of -19.1 per 1,000 (95% CI: -28.6, -9.5) (Table 5.2, Figure 5.2).

Three supplemental analyses were run to assess the changes in findings resulting from different population and outcome specifications. First, medically-indicated preterm births were identified using linked hospital discharge data and excluded from the analysis in order to obtain results specific to spontaneous preterm birth. Second, adjusted and nativity-stratified models were run among primiparous women ("primips") to remove any influence of repeat births to the same woman over the study period. Third, the models were re-run with very preterm birth (VPTB, birth before 33 completed weeks of gestational age) as the outcome. The overall pattern of results remained the same in the supplemental analyses. Adjusted estimates and estimates among foreign-born women for Hispanic and Asian density were moved somewhat toward the null when medically indicated PTBs were excluded and when the analyses were restricted to primips (Appendix 5C), but the estimated reduction in risk associated with high Hispanic density remained sizeable, if imprecise, among foreign-born black women (-12.1; 95% CI: -20.0, -4.2 for spontaneous preterm birth and -12.6; 95% CI: -26.6, 1.5 among primips). The results for VPTB show an even more dramatic relative decrease associated with high Hispanic density among the foreign born (RD=-5.7 per 1000; 95% CI: -10.4, -1.1), corresponding to a reduction in risk from 2.1% in less Hispanic neighborhoods to 1.5% in more Hispanic neighborhoods.

Finally, because Caribbean immigrants make up the majority of both the New York City Hispanic population and the foreign-born non-Hispanic black mothers in the birth records, the possibility that a shared sense of Caribbean cultural or ethnic identity makes Hispanic neighborhoods beneficial specifically for Caribbean black immigrants was considered. Foreign-born non-Hispanic black women were categorized into African and Caribbean immigrant groups, based on self-reported country of birth. Both Africans and Caribbeans appeared to benefit from residence in Hispanic neighborhoods, however (RD for Caribbeans = -10.2; 95% CI: -22.1, 1.6 and RD for Africans = -15.4; 95% CI: -34.5, 3.7), indicating that Hispanic neighborhoods afford protections to black immigrant residents from various regions.

5.5 Discussion

This investigation was motivated by the possibility that non-Hispanic black health outcomes vary not only with neighborhood-level black density, but are also differentially responsive to the presence of specific non-black ethnic groups and the social and material environments they represent. The findings of this study suggest that, at least in New York City, non-Hispanic blacks fare better with Hispanic than white neighbors. Given the high degree of deprivation associated with Hispanic neighborhoods, this result provides suggestive support for a role of psychosocial mechanisms in the relationship between neighborhoods and health outcomes, and indicates that Hispanic neighborhoods may represent favorable social environments for black residents despite their material deprivation. The available data precluded exploration of particular psychosocial variables, however, and the observational data limit the extent to which causality can be inferred from the results.

Notably, the reduction in black PTB risk associated with residence in Hispanic neighborhoods appears to be experienced almost exclusively by foreign-born black women. Foreign-born women, who are likely to be in the process of assimilating new cultural norms, may be more influenced than their US-born counterparts by elements of Hispanic neighborhoods, such as availability of Hispanic foods, that are hypothesized to be protective (38). Black immigrants may, additionally, have a more flexible racial identity than US-born blacks (177), enabling cross-ethnic ties.

This study was limited by lack of information on maternal assimilation. It may be assimilation rather than foreign birth that is the relevant stratification variable, and nativity status may be only crudely related to integration into the American mainstream. More sophisticated measures of assimilation would allow for a more nuanced understanding of the differential effect of Hispanic density observed across maternal nativity categories; the differential effect may, for example, be due to more-assimilated mothers' adoption of American racial and ethnic ideologies that create inter-ethnic hostility (177).

The lack of overlap in the range of ethnic densities across neighborhood deprivation strata suggests that neighborhood deprivation is not well controlled in the adjusted models (an example of "structural confounding" (178)). The poverty of Hispanic neighborhoods would suggest, however, that any residual confounding by neighborhood deprivation is unlikely to be responsible for the observed protective effect of Hispanic density, relative to white density, on non-Hispanic black birth outcomes.

Misclassification of gestation length, particularly misclassification that is differential across neighborhoods, is a potential concern. The study results may be biased if, like Mexican immigrants to the US (15), women in immigrant or ethnic enclaves are more likely than other women to have term births misclassified as preterm (or vice versa). To address this concern, birth weight, which is accurately measured, was used to classify births as preterm low birth weight (gestational age <37 weeks and birth weight <2500g) and very low birth weight (birth weight <1500g), two highly specific subsets of preterm birth that are unlikely to be misclassified. Models were re-run with these outcomes, and reductions in risk associated with Hispanic neighborhoods were similar to the main analyses, indicating that the main findings are not attributable to preterm birth misclassification.

The null association found between Asian density and black preterm birth may stem from the narrow range of Asian density for which the risk difference was calculated. Though the risk difference corresponding to a greater increase (0-40%) in Asian density suggests a protective role of Asian density, the imprecision of this estimate indicates that Black-Asian neighborhood interactions may still be too rare in New York City to get a useful estimate their effects.

This analysis employed a spatial measure of neighborhood-level segregation to address the documented limitations of non-spatial segregation measures. The radius, 500 meters, represents a walkable distance around the residential area (147), and was chosen as a theoretically appropriate neighborhood approximation for a population-dense urban area like New York City. Examination of between-tract distances indicated that most tracts were within 500 meters of several other census tracts (the mean distance from a tract to its nearest neighbor was 412 meters (SD=296), and half of all tracts were within 500 meters of 3 or more other tracts), so that the estimated ethnic density for most areas includes information from beyond the immediate census tract. A detailed discussion of this measure is provided in Chapters 3 and 4.

Future studies may build on the results presented here by investigating the specific psychosocial mechanisms suggested by the findings of this and other (111, 129) analyses, such as cross-ethnic solidarity among immigrants. In addition, areas where black-Asian interactions may be more common, such as Los Angeles, provide a promising context for understanding the effects of an even more diverse set of neighborhood environments. Such an understanding will identify social factors of potential importance for birth outcomes and provide information on how shifts in residential patterns might alleviate or exacerbate the burden of preterm birth in the black community.

Table 5.1 Distribution of characteristics among non-Hispanic black mothers: New York City birth records, 1995-2003

CONTINUOUS VARIABLES	MEDIAN (10TH, 90TH PERCENTILE)
Hispanic density (%)	18.7 (5.2, 61.9)
Asian density (%)	1.2 (0.3, 8.1)
White density (%)	2.2 (0.6, 23.6)
Black density (%)	64.1 (17.9, 88.9)

CATEGORICAL VARIABLES	N	%	% PTB
Age (years)			
<20	27,714	10.8%	10.8%
20-34	183,203	71.4%	10.2%
35+	45,756	17.8%	13.5%
Maternal education (years)			
<12, age<20	18,130	7.2%	11.1%
<12, age>=20	46,091	18.2%	12.0%
12	93,299	36.9%	11.0%
13-15	63,635	25.2%	10.1%
16+	31,678	12.5%	9.5%
Previous births			
1	107,920	42.1%	10.5%
2-5	144,273	56.2%	10.9%
6+	4,469	1.7%	17.3%
Prepreg. weight (pounds)*			
<125	44,777	19.0%	12.0%
125-150	86,615	36.7%	10.3%
>150	104,617	44.3%	10.0%
Tobacco use			
Nonsmoker	240,397	94.2%	10.3%
Smoker	14,690	5.8%	18.6%
Late or no prenatal care*			
No	169,652	75.0%	10.1%
Yes	56,563	25.0%	11.0%
Payment for delivery			
Private insurance	86,774	34.6%	9.9%
Medicaid	155,211	61.8%	11.0%
Self pay	9,095	3.6%	15.9%
Nativity			
US-born	141,969	55.7%	11.9%
Foreign-born	112,966	44.3%	9.5%
Residential stability			
Less stable	102,521	39.9%	10.4%
More stable	154,139	60.1%	11.1%
Neighborhood deprivation			
Richer	93,087	36.3%	10.0%
Poorer	163,559	63.7%	11.3%

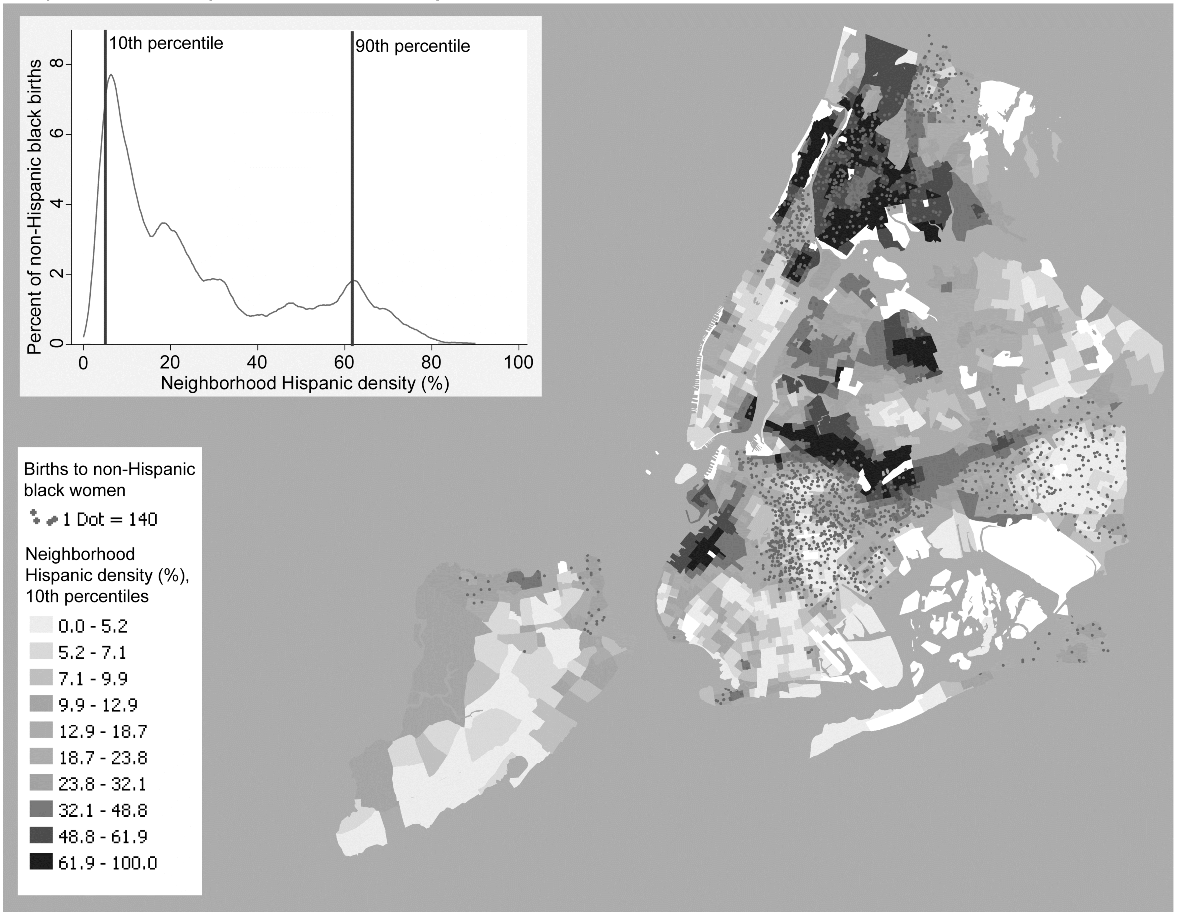
*Variables were missing for less than 4% of observations, with the exception of prepregnancy weight (8.1% missing) and prenatal care (11.9% missing)

Table 5.2 Change in preterm birth risk, with 95% confidence intervals, among non-Hispanic black women associated with increase from 10th to 90th percentiles of neighborhood Hispanic density (5.2% to 61.9% Hispanic), neighborhood Asian density (0.3% to 8.1% Asian), and neighborhood non-Hispanic black density (17.8% to 88.9% black)

ETHNIC DENSITY EXPOSURE	MODEL							
	Crude		Adjusted		Stratified: US-born		Stratified: Foreign-born	
	RD*	(95% CI)	RD*	(95% CI)	RD*	(95% CI)	RD*	(95% CI)
Hispanic	2.4	(-1.6, 6.3)	-9.6	(-16.6, -2.5)	-2.4	(-11.6, 6.8)	-19.1	(-28.6, -9.5)
Asian	-5.6	(-7.5, -3.7)	-0.6	(-3.0, 1.7)	-1.3	(-4.6, 2.0)	0.1	(-3.0, 3.1)
Non-Hispanic black	5.0	(1.4, 8.6)	-0.8	(-8.4, 6.8)	3.2	(-7.0, 13.4)	-5.3	(-15.2, 4.6)
5th to 25th percentile non-Hispanic black	11.4	(7.7, 15.1)	5.4	(1.1, 9.7)	6.4	(0.7, 12.1)	2.4	(-3.1, 7.9)

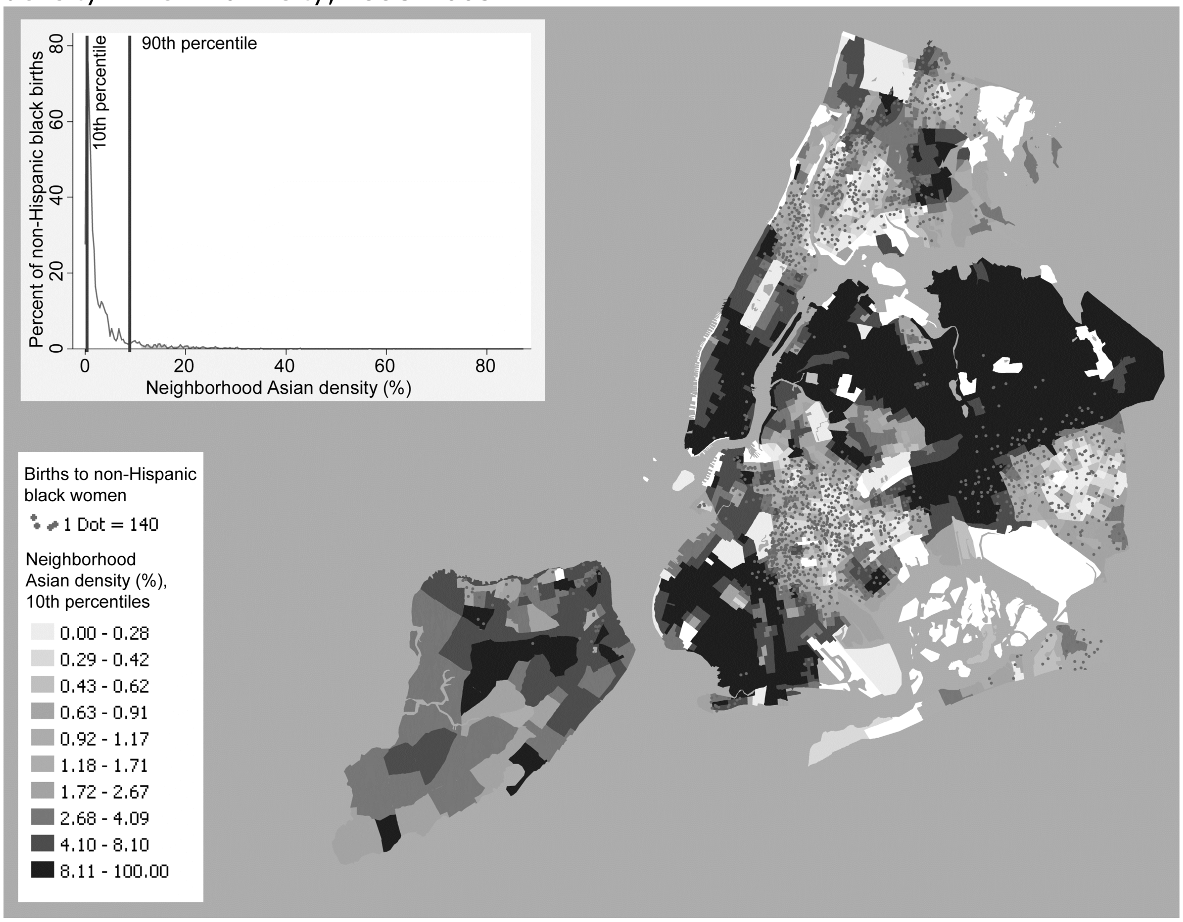
*Adjusted and stratified risk differences were calculated for women aged 20-34 who were high-school educated, had had 2-5 live births, were nonsmokers, were on Medicaid, and resided in a more stable, poorer, and white neighborhood. Adjusted (combined nativity) risk differences were calculated for US-born women.

Figure 5.1a Spatial distribution of births to non-Hispanic black women in relation to Hispanic density*: New York City, 1995-2003



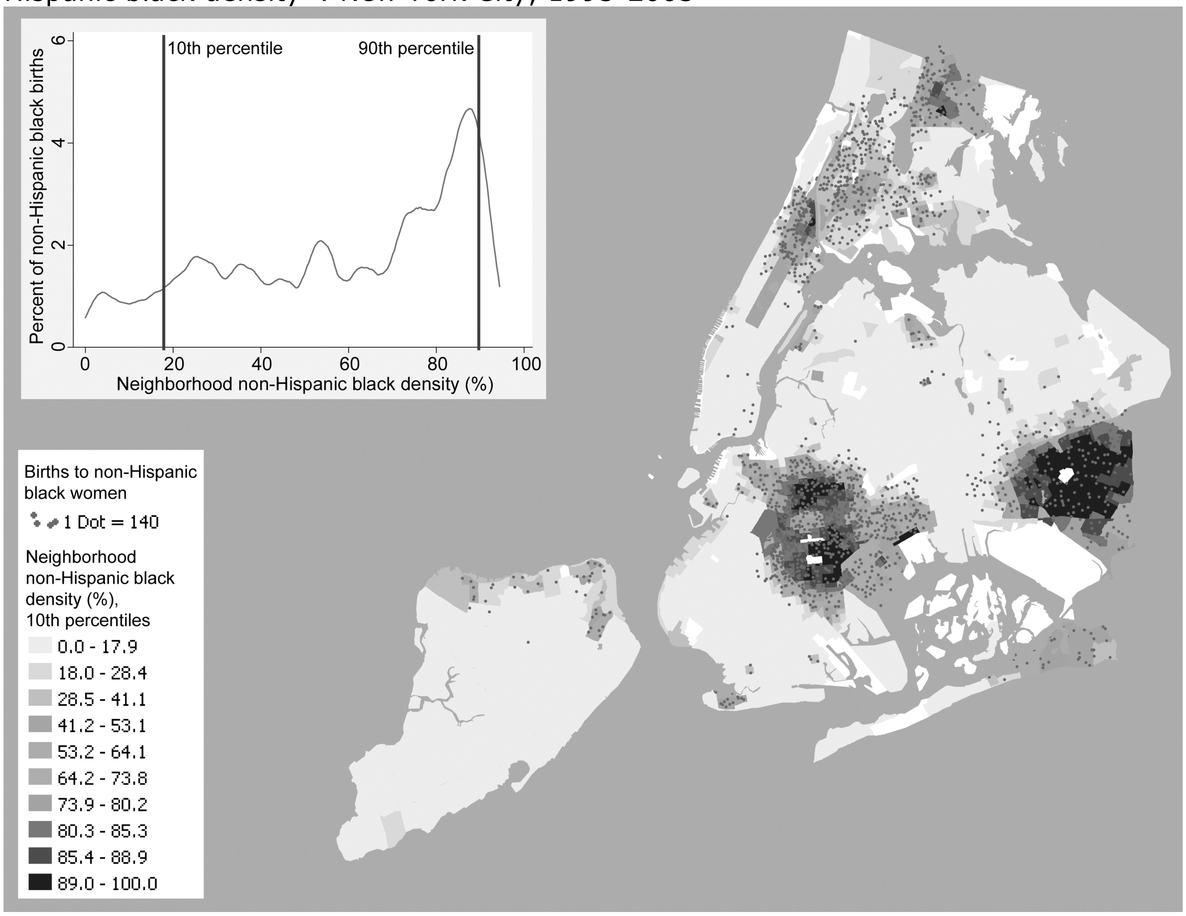
* Proximity-weighted Hispanic density computed from 2000 US Census data with a 500-meter radius, and categorized by 10th percentiles of black births.

Figure 5.1b Distribution of births to non-Hispanic black women in relation to Asian density*: New York City, 1995-2003



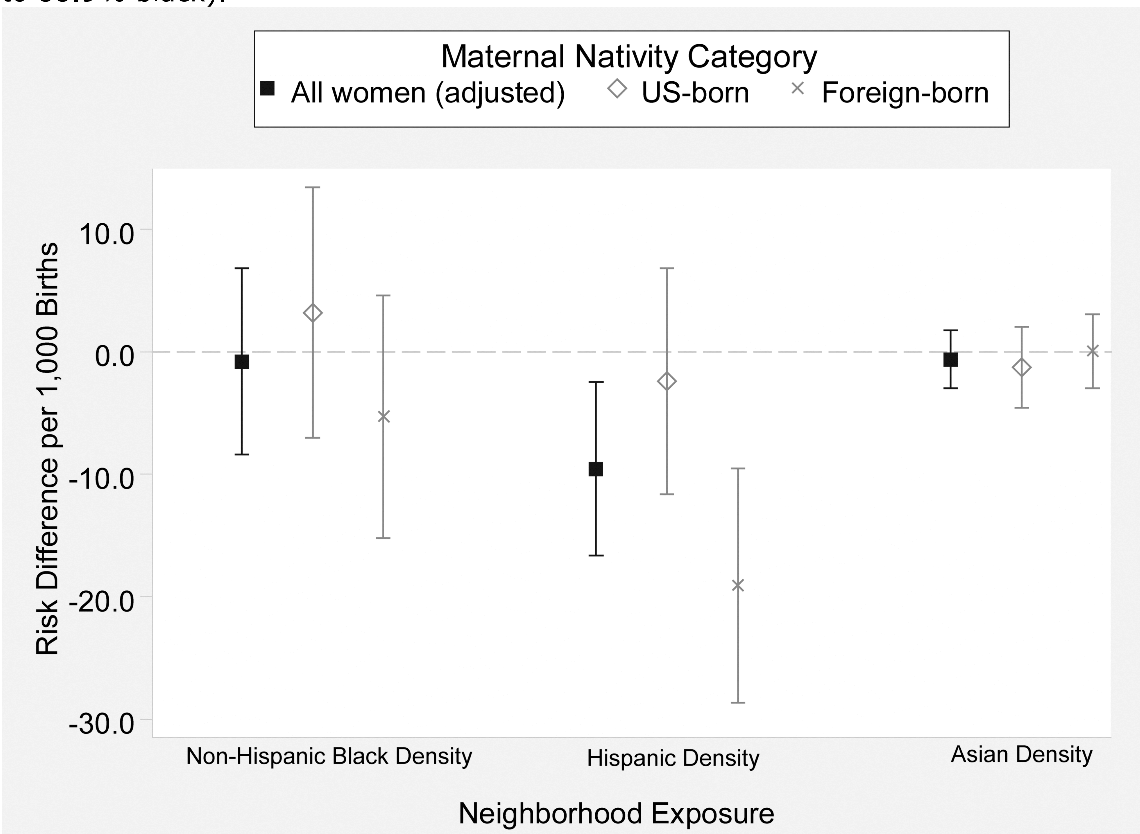
* Proximity-weighted Asian density computed from 2000 US Census data with a 500-meter radius, and categorized by 10^{th} percentiles of black births.

Figure 5.1c Distribution of births to non-Hispanic black women in relation to non-Hispanic black density*: New York City, 1995-2003



* Proximity-weighted non-Hispanic black density was computed from 2000 US Census data with a 500-meter radius, and categorized by 10th percentiles of black births.

Figure 5.2 Change in preterm birth risk*, with 95% confidence intervals, among non-Hispanic black women associated with increases from 10th to 90th percentiles of neighborhood Hispanic density (5.2% to 61.9% Hispanic), neighborhood Asian density (0.3% to 8.1% Asian), and neighborhood non-Hispanic black density (17.8% to 88.9% black).



* Risk differences were calculated for women aged 20-34 who were high school educated, had had 2-5 live births, were nonsmokers, were on Medicaid, and resided in a more stable, poorer, and white neighborhood. Adjusted (combined nativity) risk differences were calculated for US-born women.

CHAPTER 6

BLACK IMMIGRANT DENSITY AND PRETERM BIRTH RISK AMONG AFRICAN- AND CARIBBEAN- NON-HISPANIC BLACKS IN NEW YORK CITY

6.1 ABSTRACT

Background: Studies of ethnic density effects on health have largely focused on the black population in the United States (US), finding that black density is related to a variety of poor black health outcomes. Ethnic density is, however, hypothesized to be beneficial for immigrants. Studies in the US have not examined the ways that black immigrants may differ from US-born counterparts in their response to ethnic density.

Methods: Geocoded New York City birth records from 1995 through 2003 provided outcome and individual covariates, and a spatial measure of ethnic and immigrant density, computed from 2000 US Census data, was used as the exposure. The log odds of preterm birth among African-, Caribbean-, and US-born non-Hispanic black women were regressed on continuous measures of African, Caribbean, and US-born black density. The Huber-White variance was used to account for clustering by census tract. Risk differences corresponding to changes from the 10^{th} to the 90^{th} percentiles of ethnic density were computed from the logistic model coefficients.

Results: Ethnic density effects showed a similar pattern of results across all three groups: preterm birth risk was elevated in ethnically dense neighborhoods (RD for Africans =4.8 per 1,000 births, 95% CI: 2.1, 7.4, RD for Caribbeans=1.5 per 1,000; 95% CI: -3.2, 6.3 and RD for US-born=8.1 per 1,000; 95% CI: 3.3, 12.8). This elevation was exacerbated when estimated in poorer neighborhoods. US-born blacks in poor neighborhoods appeared to be especially disadvantaged by high ethnic density (RD=12.5 per 1,000; 95% CI: 6.6, 18.4).

Conclusions: While preterm birth risks among African-, Caribbean-, and US-born non-Hispanic blacks all increased with ethnic/immigrant density in poorer neighborhoods, effects for US-born blacks were particularly deleterious. US-born black women in poorer areas may perceive their neighborhoods more negatively and/or have longer-term exposure to harmful neighborhood factors than their foreign-born counterparts.

6.2 Background

Investigations into the health effects of racial residential segregation and neighborhood ethnic density in the United States (US) have focused primarily on the black population, seeking to explain stark racial disparities in a wide array of health outcomes (6, 168, 179). These studies have generally treated black Americans as a homogeneous group (31, 79, 81, 82, 85-88, 91-94, 97, 102, 103, 109, 110, 112, 114), despite recent waves of immigration from Africa and the Caribbean that make the black population – and black neighborhoods – increasingly diverse (60), and despite the fact that, like foreign-born Hispanics (25), black immigrants appear to have better health outcomes than their US-born counterparts (130-135). This limited attention to black immigrant neighborhoods represents an important gap in the literature, because ethnic density may be central to the immigrant health advantage; for example, positive immigrant health outcomes are often attributed to healthful country-of-origin foods (136), which are likely to be more accessible in immigrant areas, and to social support (77), which may be facilitated by close residential proximity of those with shared language and cultural affiliations. More broadly, it has been argued that ethnic density protects individuals belonging to minority or non-dominant groups from a sense of cultural isolation (180) and low social status (73).

A small number of studies have demonstrated that ethnic density is protective of mental health among European immigrants to the US (180-182), and there is some suggestion that ethnic density is beneficial for Hispanics (111, 122, 183). Hypotheses regarding the protective effects of immigrant enclaves for African- or Caribbean-born black immigrants in the US remain largely unexamined in the health sciences literature. One study investigated the health of Caribbean-born non-Hispanic blacks in relation to residence in largely foreign-born or linguistically isolated neighborhoods in New York City, finding that neither neighborhood characteristic is significantly predictive of Caribbean black body mass index (184). However, the study was limited by its definition of immigrant enclaves, which was based on the percent of all foreign-born individuals, regardless of country of birth, and may therefore have been unable to detect effects specific to Caribbean immigrant neighborhoods. Similarly, linguistic isolation is likely to be a poor marker of Caribbean black enclaves, as many non-Hispanic black Caribbeans in the US are English-speaking.

The positive health outcomes of most immigrant groups have led to a focus on the beneficial aspects of sending-country norms and behaviors, but immigrant cultures may not be uniformly positive, just as US culture may not be uniformly negative. Immigrant women residing in the US may, for example, have greater economic independence than they did in their countries of origin (185). Immigrant enclaves that reinforce restrictive, oppressive, or stressful aspects of sending-country norms may be health-eroding, particularly as they tend to be socioeconomically deprived (73). Black immigrants are often highly isolated from white neighborhoods (60) and the resources they represent, typically clustered within or near highly segregated US-born black neighborhoods (64). Furthermore, instead of serving as a stepping stone to spatial assimilation with non-Hispanic whites, as Hispanic and Asian neighborhoods generally do (60), black immigrant neighborhoods may be more permanent, or part of a pattern of downward assimilation into the black underclass (60, 69). The socioeconomic isolation and long-term limiting features of black immigrant neighborhoods may therefore undermine hypothesized positive elements of cultural cohesiveness.

This study uses geocoded New York City birth records and 2000 Census data to investigate the association of preterm birth risks among African- and Caribbean-born non-Hispanic black women with a spatial measure of African and Caribbean immigrant density. For comparison, the study also includes an analysis of the ethnic density—preterm birth relationship among US-born non-Hispanic black women. Preterm birth is a leading contributor to the black-white disparity in infant mortality in the US (6, 7) and is considered to be an appropriate outcome for assessing the health effects of immigrant and ethnic density because it appears to be sensitive to a variety of contextual and psychosocial stressors that may be associated with segregation (27, 41-45).

6.3 Methods

6.3.1 Data Sources and Management

New York City birth records from January 1, 1995 through December 31, 2003 provided outcome (gestational age), ethnicity, and individual-level covariate data on all births occurring in the study area over the nine-year period (N=1,084,882). The birth records were geocoded and each observation was assigned a 1990 or 2000 census tract number (depending on the year of birth) by the New York City Department of Health and Mental Hygiene. Births were excluded if they were multiple gestation pregnancies (N=17,526), occurred to women residing outside of New York City (N=14,780), were missing census tract or county information (N=108,433), or were assigned to non-existent (N=1,812), ambiguous (N=62), or unpopulated (N=28) census tracts. Births missing gestational age information (N=6,418) were also excluded.

Non-Hispanic black mothers (N=256,673) were identified as those self-reporting black race and ethnic origin in a non-Spanish-speaking country (see Figure 3.1 for details). Women born in the US made up 55% (N=141,969) of the total number of non-Hispanic black women in the birth records. Less than 1% of records (N=1,745) were missing information on maternal place of birth. Black Hispanic women were not included in this analysis, because nearly 40% of Hispanics report a racial identity of "other" on the census (149); a census-based measure of ethnic density, the basis of this analysis, was therefore thought to be unreliable for black Hispanic density.

A total of 21,088 African immigrants were identified from among the 112,959 foreign-born non-Hispanic black mothers. African immigrants were defined as those born in one of the following countries which make up the Africa region as designated by the United Nations Statistics Division (148): Algeria, Angola, Benin, Botswana, Burundi, Burkina Faso, Cameroon, Cape Verde Islands, Central African Republic, Chad, Comoro Islands, Congo (or Zaire), Cote d'Ivoire (or Ivory Coast), Djiboute, Egypt, Equitorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Libya, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe (or Rhodesia). Women reporting their place of birth as "Other African" were also included.

There were 74,718 births to black women originating from one of the following non-Spanish-speaking countries included in the Caribbean region by the United Nations Statistics Division (148): Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Bonaire, Cayman Islands, Curacao, Dominica, Grenada, Guadalupe, Haiti, Jamaica, Martinique, Montserrat, Nevis, St. Bartholemy, St. Kitts and Nevi, St. Lucia, St. Maartin, St. Martin, St. Vincent and Grenada, Tortola, Trinidad, Turks and Caicos, Virgin Islands, or West Indies. An additional 12,308 women born in Guyana, Suriname, or French Guiana – three non-Spanish-speaking countries on the Caribbean coast of South America – were also included, bringing the total number of non-Hispanic black Caribbeans to 87,026. A sensitivity analysis was conducted with women from these three countries excluded to ensure that changes in the region's definition did not change the study findings.

Around 4% (N=4,845) of the births to non-Hispanic black immigrants were not African or Caribbean and were therefore excluded from the analyses. Around half of these were to women born in the United Kingdom, Europe, or Canada.

In order to create consistent tract numbers over the 1990 and 2000 Censuses, 1990 US Census tracts that were absorbed into another tract in the 2000 Census were assigned the 2000 tract numbers. Likewise, year 2000 tracts that were split from 1990 tracts were merged back to their "parent" tracts and assigned the 1990 tract numbers (140).

Summary File 4 (SF4) from the 2000 US Census provided population counts for non-Hispanic blacks born in Africa, the Caribbean, and the US for 2,105 of the 2,217 census tracts in New York City. The 111 tracts not found in the SF4 were excluded by the Census Bureau either because they had fewer than 100 people in any ethnic group, or because they had fewer than

50 unweighted sample cases (156). Twenty-four births to non-Hispanic black African immigrants, 65 births to non-Hispanic black Caribbean immigrants, and 209 births to US-born non-Hispanic blacks were excluded from the analysis because they occurred to women in a census tract that did not appear in the SF4 due to insufficient population and were therefore missing exposure information. This left 21,064 black African births in 1,452 tracts, 86,961 black Caribbean births in 1,797 tracts, and 141,760 black American births in 1,885 tracts for the analyses.

In addition to excluding certain census tracts altogether, the Census suppressed population counts for African-, Caribbean-, and US-born non-Hispanic blacks in census tracts that had fewer than 100 non-Hispanic black residents (US- and foreign-born combined) (156). This resulted in missing exposure data for 8.1% of African births, 5.8% of Caribbean births, and 6.5% of births to US-born black women. Unlike excluded census tracts, those with suppressed African, Caribbean, and American black populations had substantial numbers of individuals from other groups. Therefore, suppressed black population counts were assumed to be trivial relative to the total population of the tract, and were set to zero; a supplemental analysis was conducted with these tracts excluded to assess the extent to which they influenced the findings.

Area-level covariates were obtained from Summary File 3 of the 2000 US Census.

6.3.2 Variables and Variable Construction

The outcome, preterm birth, was defined as a live singleton birth at greater than 20 but less than 37 completed weeks of gestation using the clinical estimate of gestational age (1).

The exposure, neighborhood immigrant or ethnic density, was defined as the percentage of the population in an African-, Caribbean-, or US-born non-Hispanic black woman's area of residence that self-reported being non-Hispanic black and born in Africa, the Caribbean, or the US, respectively. Following Reardon and Firebaugh (138, 162), the areas nearest a woman were assumed to contribute most to her experience of neighborhood-level immigrant or ethnic density. Populations farther away were allowed to influence her estimated exposure as well, but this influence decreased in proportion to distance. Because they were the smallest unit available in the birth records, census tracts were used to locate the women geographically, and the distance from each woman's residence to other populations was estimated using the distances between approximate census tract centers (centroids). New York City census tracts are geographically small, with a mean area of 354,340 square meters (0.14 square miles) and a median of 180,403 square meters (0.07 square miles). The position of centroids was calculated using a center-of-mass generator in (142), and between-centroid distances were then computed in ArcGIS (ESRI).

The proximity-weighted immigrant or ethnic density (138) (subsequently referred to as "ethnic density" or "immigrant/ethnic density") experienced by a woman of immigrant or ethnic group *M* residing in census tract *J* (Π_{JM}) was calculated by multiplying the population count in each census tract *K* of those sharing her immigrant or ethnic identity (x_{KM}) by a weight (p_{JK}) that represents the proximity of tracts *J* and *K*. These weighted ethnic populations were summed and then divided by total census tract populations (x_K) that were weighted in the identical manner. This produced a weighted "percent" as shown below:

$$\Pi_{JM} = \frac{\sum_K (x_{KM} \times p_{JK})}{\sum_K (x_K \times p_{JK})}$$

The proximity weight (p_{JK}), a "biweight kernel", allows census tract *K*'s influence to decay in an approximately Gaussian manner with its distance from census tract *J* (147):

$$p_{JK} = \left(1 - \frac{(d_{JK})^2}{r}\right)^2 \text{ if } r<c\text{, else } p_{JK}=0$$

Where d_{JK} is the distance between census tracts *J* and *K*. Note that if *J*=*K*, then d_{JK} = 0 and p_{JK} = 1; that is, a census tract's own ethnic composition will have maximal influence on the estimated exposure of the residents of that census tract. The variable *r* is the distance from census tract *J* beyond which there is no influence on *J's* estimated ethnic density. The value of the radius, *c*, is chosen based on the hypothesized area thought to meaningfully affect the environment of those living in census tract *J*. Lee and colleagues suggest a radius of 500m to approximate residential areas accessible by foot (147), which was considered to be an appropriate neighborhood definition for New York City; other suggested radii represented distances more often traveled by car.

The following covariates were included in adjusted models: maternal age (indicators for <20, 20-34, and 35+ years, with 20-34 as the referent), education taking age into account (indicators for <12 years and <20 years of age, <12 years and 20+ years of age, 12 years, 13-15 years, and 16+ years, with 12 years as the referent), parity (indicators for 1, 2-5, and 6+ previous births, with 2-5 as the referent), tobacco use (smoker or nonsmoker, with nonsmoker as the referent), prepregnancy weight (indicators for <125, 125-150, and >150 pounds, with 125-150 as the referent), prenatal care received in first 120 days of gestation (yes or no, with yes as the referent), and payment type (indicators for private insurance, Medicaid, or out-of-pocket, with Medicaid as the referent). Finally, residential stability (percent of the neighborhood population residing in the same house from 1995 to 2000) and neighborhood deprivation, both dichotomized at the median, were included as contextual-level covariates with more-stable and poorer tracts chosen as the reference groups.

Neighborhood deprivation was represented using a standardized index arising from 17 tract-level census variables (% of the population with less than a high-school education, % unemployed, % males not in work force, % crowding, % renter-occupied units, % male professionals, % female professionals, % males in management, % females in management, % poverty, % female-headed household with children, % households with <$30,000/year, % households on public assistance, % households with no car, median household income, median income of individuals with earnings, median value of owner-occupied units) that were summarized using principle components analysis as described by Messer et al. (151). Both residential stability and the component variables of the neighborhood deprivation index were proximity-weighted in the same manner as ethnic density.

6.3.3 Data Analysis

Logistic regression was used to model the relationship between proximity-weighted ethnic density and preterm birth, with the Huber-White "sandwich" variance estimator employed to account for clustering at the census tract level (155). The coefficients from the adjusted marginal models closely approximated the results from random-intercept models, for which the estimated intra-cluster correlation coefficients were small (0.013 for African-born blacks, and <0.002 for Caribbean- and US-born blacks); the marginal models were chosen over the random intercept models, because it is argued that results from marginal models are more appropriate for public health inference (154).

To make the results more directly relevant for public health and policy application, the logistic regression model coefficients were used to compute risk differences (RDs). Risk differences provide an estimate of the number of preterm births attributable to (or prevented by) the exposure (assuming the modeled associations are valid and causal).

Three sets of models were run, one each for African-, Caribbean-, and American-born non-Hispanic black women. The following modeling strategy was common to all three groups and was designed to estimate the ways that preterm birth risk changes as a woman is increasingly exposed to others with her ethnic and immigrant identity. First, crude estimates were obtained by regression of the log odds of preterm birth among African-, Caribbean-, and American-born non-Hispanic black women on African, Caribbean, and American black densities, respectively. Ethnic densities were included in the models as continuous variables, because the log odds of preterm birth was roughly linearly related to ethnic density among Africans and Caribbeans; a squared term in the US-born model accommodated a curvilinear ethnic density—preterm birth association.

Second, adjusted estimates were obtained from the three models run with all individual- and contextual-level covariates. Third, reduced models were run without the two most frequently missing covariates: pre-pregnancy weight and early prenatal care. Around 14% of births to Caribbean women and 18% births to African and US-born black women were missing data on one or both of these variables. A change-in-estimate analysis was conducted to assess the extent of confounding incurred by their exclusion; omission of these variables was considered worthwhile for the gain in precision and generalizability if it changed the risk difference by less than 2 PTBs per thousand births.

Fourth, neighborhood deprivation was investigated as a potential effect measure modifier, because the association between preterm birth and the psychosocial correlates of segregation depend on the resource environment that is also present. Stratified risk differences were presented only if estimates for at least one of the groups differed by more than 5 PTBs per thousand births across strata.

Differences in preterm birth risk were calculated for a change from the 10th to the 90th percentiles of ethnic density for each group. The 10th percentile of African density experienced by black African immigrants in the birth records corresponded to 0.2% African, while the 90th percentile corresponded to 7.0% African; that is, 10 percent of black African births occurred to women residing in neighborhoods that were less than 0.2% African and 90% occurred to women residing in neighborhoods that were less than 7.0% African. The 10th and 90th percentiles for Caribbean density were 2.3% and 39.5%, respectively, while for US-born blacks they were 13.0% and 70.1%, respectively. The RDs were computed for US-born women aged 20-34 who were high school-educated, had 2-5 previous live births, received early prenatal care, were on Medicaid, and resided in a more stable and poorer neighborhood.

6.4 RESULTS

Births to non-Hispanic black immigrant women were over-represented in the birth records when compared to the general population of non-Hispanic blacks in New York City, indicating higher fertility among the foreign-born: almost half of non-Hispanic black births were to immigrants, while just 30% of the non-Hispanic black population was foreign-born (2000 US Census). Among black immigrants, Africans were overrepresented in the birth records, making up 18% of the births but just 10% of the population; in contrast, Caribbeans represented almost 75% of black immigrants but only 66% of the black immigrant births. Figures 6.1a-c show the distribution of births to black African immigrants, black Caribbean immigrants, and US-born black women in relation to their group ethnic/immigrant density. Around 80% of the African births were to women originating from one of the following seven countries in Western African: Gambia, Ghana, Guinea, Ivory Coast, Mali, Nigeria, and Senegal. Forty percent of Caribbean births were to Jamaican women, 21% were to Haitian women, and 18% were to Trinidadians.

African-born black women had low rates of preterm birth (7.5%) relative to Caribbean- (9.9%) and US-born blacks (11.9%). Consistent with their comparatively low risk, African mothers were least likely to report smoking during pregnancy (Table 6.1); however, they were also least likely to have received early prenatal care or to have private health insurance. Caribbean mothers were most likely to have received at least a high school education and to live in a wealthier neighborhood, and they were less likely than US-born black mothers to have smoked during pregnancy. In other respects, the risk profile of Caribbean immigrants closely resembled that of their US-born counterparts.

African mothers residing in neighborhoods with a high density of African immigrants tended to be younger and less educated than those in less African areas, and African neighborhoods were more likely to be poor (data not shown). Among Caribbeans, ethnic density was not highly related to maternal age or education, but was associated with heavier pre-pregnancy weight and receipt of Medicaid. More densely Caribbean neighborhoods were also poorer than less Caribbean ones. Like Africans, US-born blacks were slightly younger and less educated if they lived in black neighborhoods, and US-born black neighborhoods were poorer.

Crude models indicated that African-, Caribbean-, and US-born black density were all associated with increased risks of preterm birth. US black density was associated with a greater increase in risk (RD=12.5 per 1,000; 95% CI: 7.4, 17.6) than African (RD=4.8 per 1,000; 95% CI: 1.0, 8.5) or Caribbean (RD=4.3 per 1,000; 95% CI: -1.1, 9.7) densities (Table 6.2).

Adjustment for individual- and area-level covariates did not greatly change the African estimate (RD=4.8 per 1,000, 95% CI: 2.1, 7.4), but moved the Caribbean and US-born estimates toward the null (Caribbean RD=1.5 per 1,000; 95% CI: -3.2, 6.3 and US-born RD=8.1 per 1,000; 95% CI: 3.3, 12.8). Like the crude estimates, the adjusted risk differences indicated that increasing African- and US-born black densities are related to increased preterm birth; among Caribbean-born women, the Caribbean density—preterm birth association was close to the null. Estimates are presented from the model without the pre-pregnancy weight and prenatal care variables, because their exclusion changed the estimated risk differences by less than 2 per 1,000; Appendix 6A provides estimates from the fully-adjusted models for comparison.

When stratified by neighborhood deprivation, the risk differences estimated in wealthier neighborhoods were lower than the estimates in poorer neighborhoods for all three groups (Figure 6.2, Table 6.2). Among Africans, the difference in RDs across strata was small (RD for wealthier neighborhoods = 2.8 PER 1,000; 95% CI: -1.4, 7.0. RD for poorer neighborhoods = 6.1 per 1,000; 95% CI: 1.9, 10.2). The change in the risk difference across strata was larger for Caribbean women: the RD for wealthier neighborhoods was -1.5 per 1,000 births (95% CI: -8.6, 5.5), while the RD for poorer neighborhoods was 4.4 per 1,000 (95% CI: -1.6, 10.4), but the confidence intervals were wide and overlapping. Among US-born blacks, the effect modification was clearer: the RD in wealthier neighborhoods was -4.0 per 1,000 (95% CI: -12.1, 4.2) while in poorer neighborhoods it was 12.5 per 1,000 (95% CI: 6.6, 18.4).

To address the possibility that associations between black immigrant density and poor birth outcomes were a spurious result of the proximity of black immigrant enclaves to US-born black neighborhoods, African and Caribbean models were re-run with US-born black density included as a control variable. Results for Africans moved slightly toward the null but remained elevated when US-born black density was accounted for; among Caribbeans, controlling for US-born black density moved estimates away from the null, though the confidence intervals widened considerably (Appendix 6B).

Several additional sensitivity analyses were conducted to assess the extent of bias incurred by certain variable and population specifications (Appendices 6B and 6C). First, census tracts in which the relevant ethnic or immigrant population counts were suppressed were excluded from the models (in the main analyses, the ethnic or immigrant population was assumed to be zero in these tracts). Second, the analyses were restricted to primiparous women ("primips") to eliminate the influence of repeat births to the same women. Third, linked hospital discharged data were used to identify and exclude medically-indicated PTBs in order to obtain results specific to spontaneous preterm birth. Finally, the Caribbean models were re-run with women from the South American countries of French Guiana, Guyana, and Suriname excluded. The findings remained largely unchanged in all supplemental analyses, with the exception of restriction to primips. The RDs for African primips were elevated in wealthier neighborhoods and null in poorer neighborhoods, the opposite of the pattern observed in the main analyses, while among Caribbeans the estimates among primips were more pronounced than the main estimates; the confidence intervals of the primip estimates were, however, very wide, encompassing the point estimate and most of the confidence interval range of the main results, making it difficult to tell whether the primip-specific estimates truly differed from the main estimates.

To assess the potential impact of gestation length misclassification on the results, models were re-run with low birth weight (<2500g) preterm births, which are unlikely to be misclassified. Results were similar to main results, except that African RDs were higher in less deprived neighborhoods and lower in more deprived neighborhoods.

For better comparability between immigrant and US-born ethnic density effects risk differences were also for an absolute change from 2% to 40% own-group density for Caribbean and US-born women (Web Table 5). African ethnic density levels were not high enough to include in this sub-analysis. Adjusted RDs for US-born (10.8 per 1,000; 95% CI: 4.5, 17.1) were substantially higher than RDs for the same contrast among Caribbean-born women (RD=1.5; 95% CI: -3.4, 6.3).

To get additional information on how ethnic density effects might differ across country-specific immigrant groups, models were re-run for the two most prevalent African sub-groups (Nigerians and Ghanaians) and Caribbean subgroups (Jamaicans and Haitians). The results indicated some differences in the ethnic density response by country of birth (Appendix 6D), with Nigerians appearing to benefit from ethnic density in wealthier neighborhoods, but the results were too imprecise to provide strong support of heterogeneity across sub-groups. The pattern of estimates across wealthier and poorer neighborhoods in these sub-groups echoed the larger group patterns, with risk differences in wealthier neighborhoods showing a protective or null effect of ethnic density, and higher (more positive) risk differences observed in poorer neighborhoods.

6.5 Discussion

In this study, residence near high proportions of their own ethnic group was associated with an increase in preterm birth risk among non-Hispanic black African-, Caribbean-, and US-born women, especially in more deprived neighborhoods. Risk differences for both relative (10^{th} to 90^{th} percentile) and absolute (2% to 40%) increases in ethnic density suggest that US-born non-Hispanic blacks experience substantially more harm from residence in ethnically dense poor neighborhoods than Caribbean-born non-Hispanic blacks. Lack of variability in African density hindered comparison of African effects with the other groups: 90^{th} percentile African neighborhoods were only 7% African, while 90^{th} percentile Caribbean and US-born neighborhoods had densities of 40% and 70%, respectively.

The distinctive results among US-born women suggest that US-born black neighborhoods have a different balance of burdens and resources than do black Caribbean immigrant enclaves. Sociologists have, for example, documented ethnically-based systems of resource sharing in Caribbean immigrant enclaves (64) that may counteract broader material deprivation. Ethnographic work also suggests that black immigrants perceive fewer race-based barriers to success (177) and less racism (186) than their US-born counterparts, and, like many immigrant groups (60), black immigrants may view their neighborhoods as a temporary step toward assimilation with whites. Given this perspective, black immigrants may be less likely to view their neighborhoods as a product of racial discrimination than US-born blacks, who may perceive black neighborhoods, particularly poor ones, as the culmination of decades of racial oppression, limited opportunities, and white flight. The differential effect of ethnic density on immigrants versus US-born women may thus reflect differences in the psychosocial correlates, such as feelings of powerlessness, of residence in immigrant versus US-born black enclaves. Unfortunately, the data used for this analysis did not allow for exploration of this potential mechanism.

Contrary to theories suggesting that immigrant enclaves are health-promoting (73, 180) and in contrast to the findings for Hispanics, (111, 116-119, 121, 122), black immigrant enclaves were not associated with reduced preterm birth risks in. Black immigrant areas, especially poor ones, may have negative characteristics that outweigh the potential benefits of cultural or ethnic cohesiveness; Hispanic cultures may, alternatively, be uniquely health-protective.

Interpretation of the estimated ethnic density—preterm birth association for Africans is hindered by low African density. The most African neighborhoods were only 7% African, a level that may not meaningfully influence the social environment, and the ethnic density-preterm birth association measured may be a result of other neighborhood characteristics that covary with the presence of African immigrants. It is also possible, however, that segregation of Africans occurs at a smaller scale than was captured by the measure used (e.g. along a single street or block face). In this case, the larger-scale measure may be a diluted but meaningful marker of African enclaves. Examination of smaller-scale segregation may be worthwhile when exact residential addresses are available.

A major limitation of the data used for this analysis was lack of information on mothers' assimilation. Highly assimilated foreign-born women may differ little from the US-born in their response to ethnic density, and their inclusion with the African and Caribbean immigrants may have prevented detection of protective immigrant enclave effects in the less-assimilated. The data also lacked information on the timing of the mothers' residence in their neighborhoods, and thus the results could not take into account the length of neighborhood exposure, which likely differs for immigrants and the US-born.

This analysis is the first to investigate health outcomes in black immigrant neighborhoods, despite recent interest in the health effects of residential segregation (78). In addition to the its substantive contribution, this study used a spatial measure of ethnic density, to avoid "aspatial" measures' potential mischaracterization of geographic population distributions (139). The results suggest that ethnic density is associated with poor birth outcomes among non-Hispanic black Caribbean immigrants to the US, but that the effects are small compared to those among US-born blacks. Similar negative responses to ethnic density may, however, emerge among black immigrants as they accumulate experiences of racial oppression and adopt racial attitudes similar to their US-born counterparts (177). Further studies of black immigrants using detailed assimilation measures may help to explain the erosion of immigrant health associated with time in the US and point to contextual and psychosocial sources of the notable health disadvantage experienced by the US-born black population.

Table 6.1 Characteristics of African-, Caribbean-, and US-born non-Hispanic black mothers: New York City birth records, 1995-2003

	ETHNIC/IMMIGRANT GROUP								
	African-born			Caribbean-born			US-born		
CATEGORICAL VARIABLES	N	%	%PTB	N	%	%PTB	N	%	%PTB
Age (years)									
<20	522	2.5%	7.9%	4,772	5.5%	9.9%	21,939	15.5%	11.1%
20-34	15,771	74.9%	7.0%	60,951	70.1%	9.2%	101,579	71.7%	11.3%
35+	4,771	22.7%	8.9%	21,238	24.4%	12.3%	18,242	12.9%	16.1%
Maternal education (years)									
<12, age<20	358	1.7%	7.5%	2,704	3.2%	10.4%	14,781	10.6%	11.4%
<12, age>=20	5,729	27.9%	6.8%	12,776	14.9%	10.2%	26,709	19.1%	13.9%
12	7,297	35.5%	8.0%	35,916	41.9%	10.1%	47,669	34.0%	12.1%
13-15	3,382	16.5%	7.8%	21,846	25.5%	9.5%	36,772	26.3%	10.7%
16+	3,796	18.5%	7.4%	12,452	14.5%	10.2%	14,089	10.1%	9.6%
Previous births									
1	7,336	34.8%	8.4%	36,115	41.5%	10.5%	61,404	43.3%	10.8%
2-5	13,506	64.1%	7.0%	50,036	57.5%	9.7%	77,010	54.3%	12.4%
6+	222	1.1%	8.1%	810	0.9%	13.2%	3,336	2.4%	19.0%
Prepreg. weight (pounds)*									
<125	2,693	14.3%	7.8%	15,518	19.3%	9.8%	25,314	19.4%	13.9%
125-150	8,077	42.8%	7.2%	31,042	38.5%	9.6%	45,132	34.6%	11.5%
>150	8,109	43.0%	7.5%	34,065	42.3%	10.0%	60,104	46.0%	10.4%
Tobacco use									
Nonsmoker	20,930	99.7%	7.5%	85,581	99.0%	10.0%	127,319	90.4%	11.1%
Smoker	62	0.3%	17.7%	866	1.0%	13.7%	127,319	9.6%	18.9%
Late or no prenatal care*									
No	13,377	70.9%	7.3%	58,815	76.2%	9.7%	93,171	74.9%	10.8%
Yes	5,488	29.1%	6.7%	18,403	23.8%	9.4%	31,250	25.1%	12.7%
Payment for delivery									
Private insurance	4,891	23.5%	8.4%	30,289	36.0%	10.0%	48,872	35.1%	10.0%
Medicaid	14,859	71.5%	6.9%	50,553	60.1%	9.6%	86,077	61.7%	12.6%
Self pay	1,045	5.0%	10.8%	3,266	3.9%	14.7%	4,472	3.2%	17.7%
Residential stability									
Less stable	11,322	53.8%	7.2%	35,503	40.8%	9.9%	52,321	36.9%	11.6%
More stable	9,742	46.3%	7.9%	51,458	59.2%	10.1%	89,439	63.1%	12.0%
Neighborhood deprivation									
Richer	6,074	28.8%	8.0%	42,396	48.8%	9.9%	41,654	29.4%	10.4%
Poorer	14,988	71.2%	7.3%	44,564	51.3%	10.2%	100,103	70.6%	12.4%

CONTINUOUS VARIABLES (PERCENTILES)	Median	10th	90th	Median	10th	90th	Median	10th	90th
Group density†	2.2%	0.2%	7.0%	22.5%	2.3%	39.5%	40.8%	13.0%	70.1%

*All variables were missing for less than 4% of observations, except pre-pregnancy weight (missing for 10.4% of African, 7.3% of Caribbean, and 7.9% of US-born records) and timing of prenatal care (missing for 10.4% of African, 11.2% of Caribbean, and 12.2%% of US-born records).

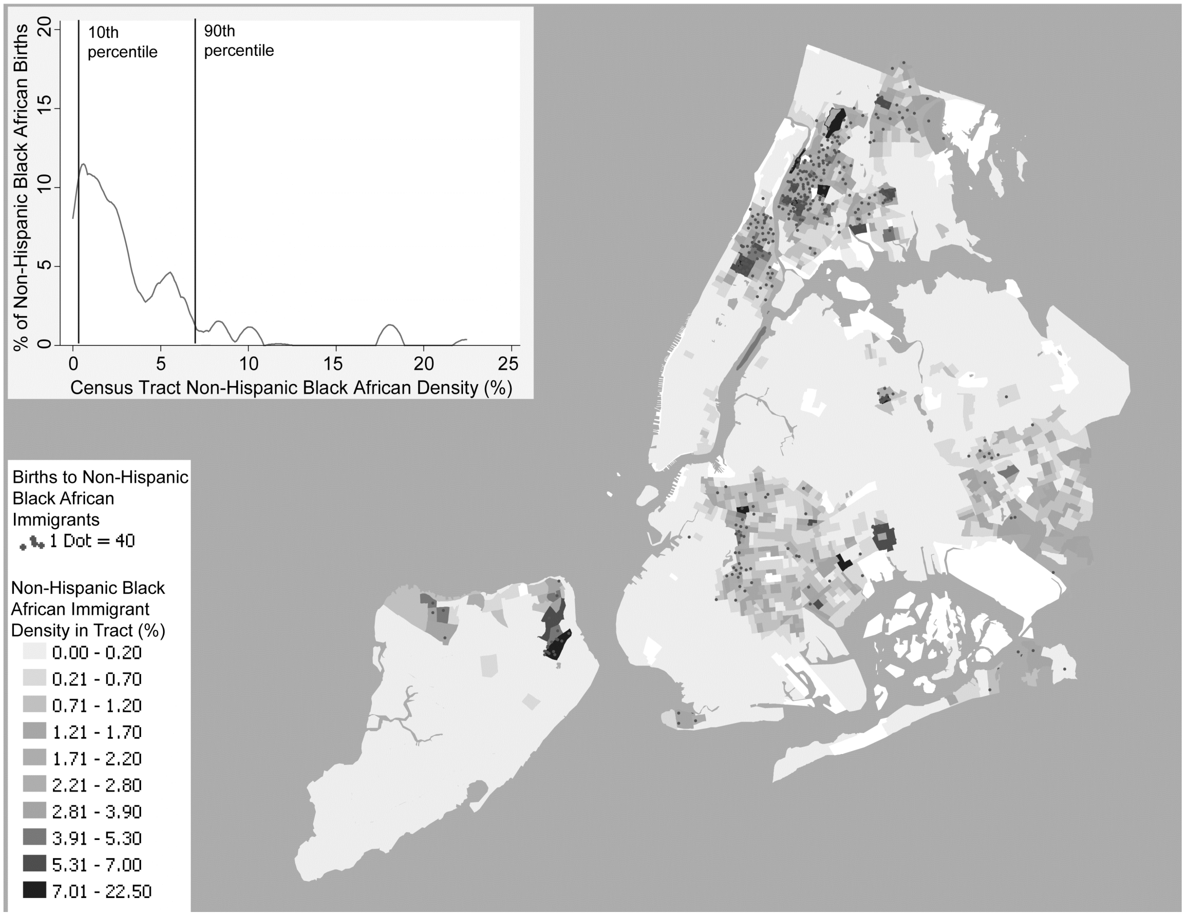
†Group density is the proximity-weighted proportion of the neighborhood that shares the mother's ethnic and immigrant identity.

Table 6.2 Risk differences for African-, Caribbean-, and US-born non-Hispanic black women associated with neighborhoods in the 90th percentile of ethnic/immigrant density compared to 10th percentile neighborhoods

Immigrant/Ethnic Group	Model							
	Crude		Adjusted		Stratified: Richer neighborhoods		Stratified: Poorer neighborhoods	
	RD*	(95% CI)	RD*	(95% CI)	RD*	(95% CI)	RD*	(95% CI)
African-born	4.8	(1.0, 8.5)	4.8	(2.1, 7.4)	2.8	(-1.4, 7.0)	6.1	(1.9, 10.2)
Caribbean-born	4.3	(-1.1, 9.7)	1.5	(-3.2, 6.3)	-1.5	(-8.6, 5.5)	4.4	(-1.6, 10.4)
US-born	12.5	(7.4, 17.6)	8.1	(3.3, 12.8)	-4.0	(-12.1, 4.2)	12.5	(6.6, 18.4)

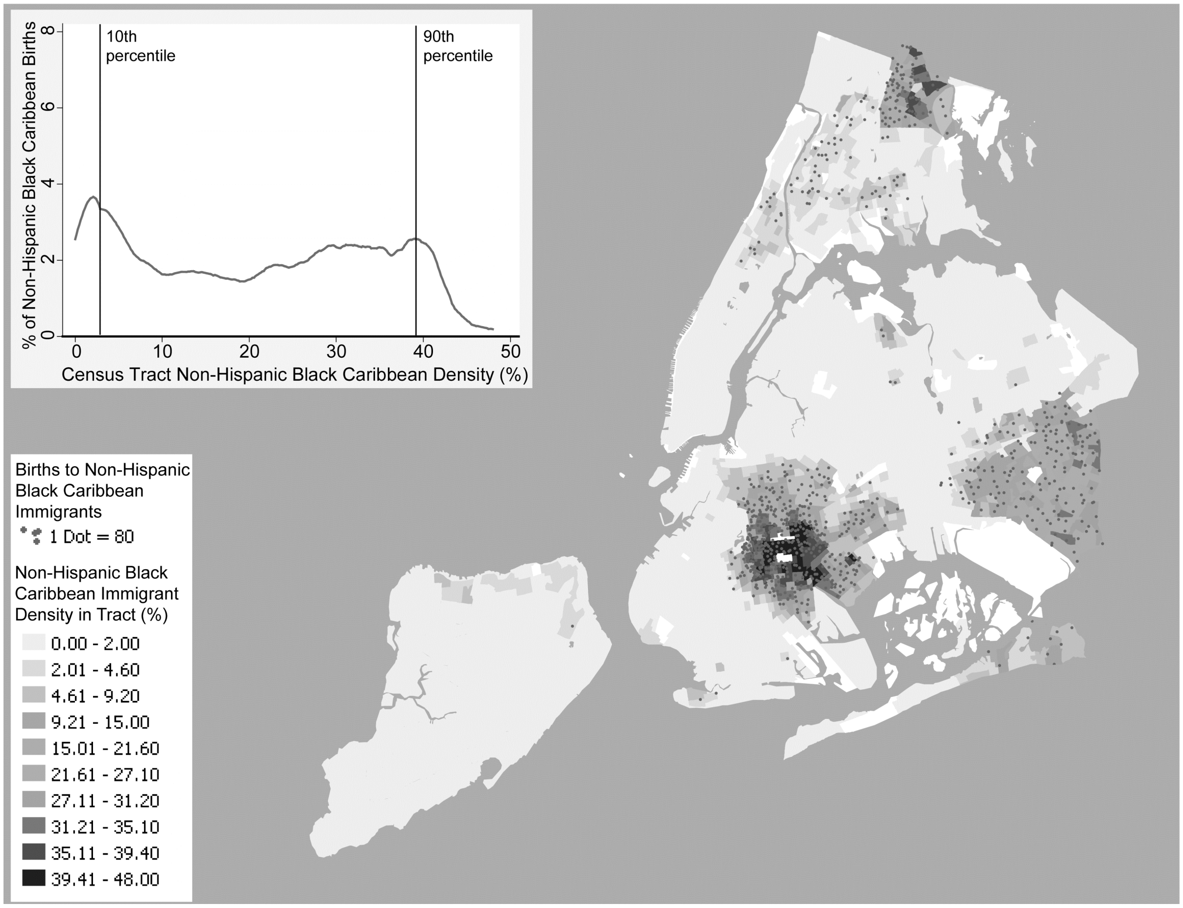
* Risk differences correspond to a change from 10th to 90th percentiles of ethnic or immigrant density. Adjusted and stratified risk differences were calculated for women aged 20-34 who were high school-educated, had had 2-5 live births, were nonsmokers, were on Medicaid, and resided in a more stable neighborhood. Adjusted risk differences were calculated for poorer neighborhoods.

Figure 6.1a Spatial distribution of births to African-born non-Hispanic black women in relation to non-Hispanic black African immigrant density*: New York City, 1995-2003



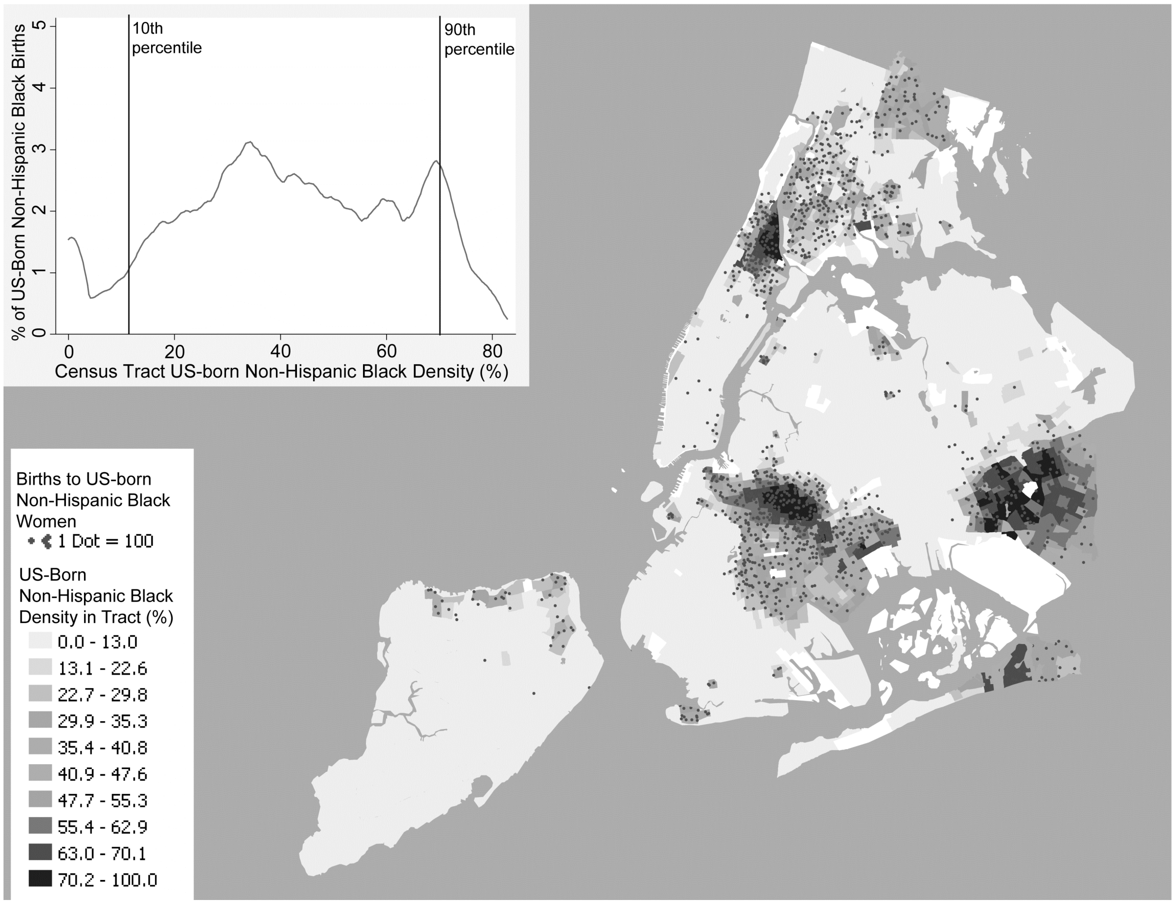
* Proximity-weighted non-Hispanic black African immigrant density was computed from 2000 US Census data with a 500-meter radius, and categorized into 10th percentiles.

Figure 6.1b Spatial distribution of births to Caribbean-born non-Hispanic black women in relation to non-Hispanic black Caribbean immigrant density*: New York City, 1995-2003



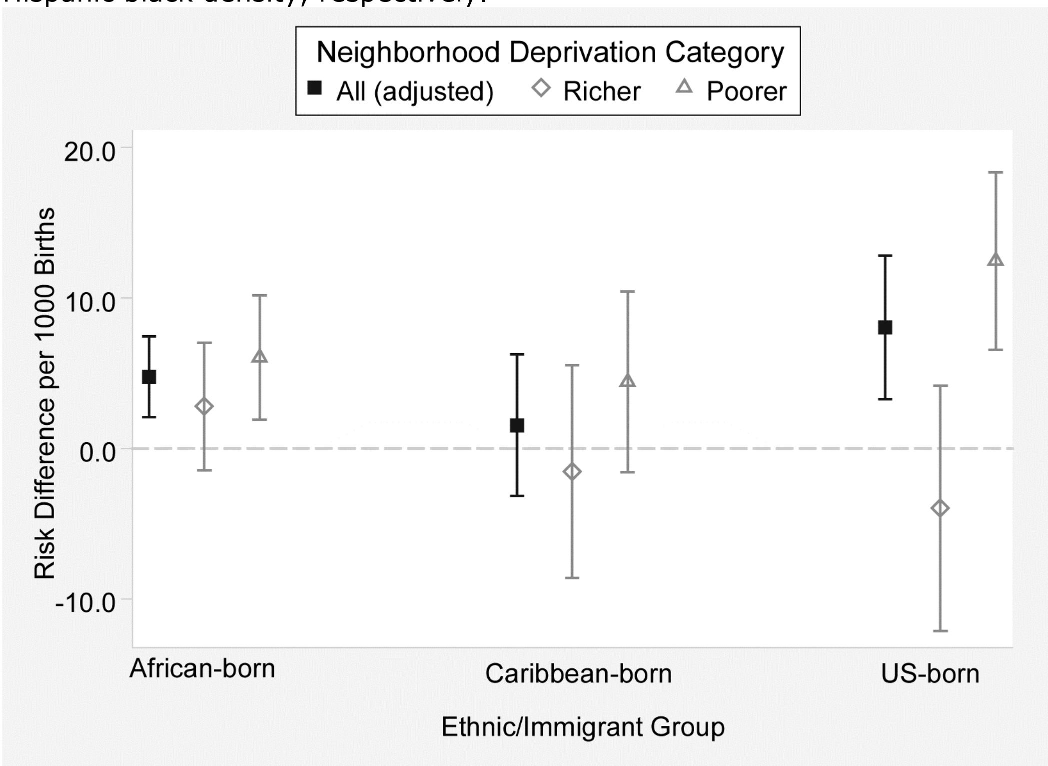
* Proximity-weighted non-Hispanic black Caribbean immigrant density was computed from 2000 US Census data with a 500-meter radius, and categorized into 10th percentiles.

Figure 6.1c Spatial distribution of births to US-born non-Hispanic black women in relation to US-born non-Hispanic black density*: New York City, 1995-2003



* Proximity-weighted US-born non-Hispanic black density was computed from 2000 US Census data with a 500-meter radius, and categorized into 10th percentiles.

Figure 6.2 Change in preterm birth risk*, with 95% confidence intervals, for African-, Caribbean-, and US-born non-Hispanic black women associated with increase from 10th to 90th percentiles of non-Hispanic black African immigrant density, non-Hispanic black Caribbean immigrant density, and US-born non-Hispanic black density, respectively.



* Risk differences were calculated for women aged 20-34 who were high-school educated, had 2-5 live births, were nonsmokers, had private insurance, and resided in a more stable, poorer, and white neighborhood. Adjusted (combined nativity) risk differences were calculated for US-born women.

CHAPTER 7

DISCUSSION

The three studies presented here investigated the possibility that ethnic density effects vary both across ethnic groups and within the black population by neighborhood ethnic composition and immigrant status. Analysis results suggested that for most ethnic groups – non-Hispanic whites, three Hispanic groups, and two Asian groups – ethnic density is neutral or protective in terms of preterm birth risk. The protective effects were more pronounced in poorer neighborhoods, where the psychosocial benefits thought to be provided by ethnic density (73) may be important for counteracting material deprivation. Non-Hispanic whites, in particular, had substantially reduced risks of preterm birth in white enclaves, which have historically served to maintain white economic and social privilege (52). Non-Hispanic blacks, on the other hand, stood out as a notable exception to this pattern of health-positive responses to ethnic density; preterm birth risk among non-Hispanic blacks was elevated in black neighborhoods, and this elevation appeared to be exacerbated in poorer areas.

Further examination of non-Hispanic black birth outcomes across different types of neighborhoods indicated that black preterm birth risk was especially low in Hispanic neighborhoods, although this response appeared to be limited to foreign-born blacks. The reasons for this are unclear, but may be related to hypothesized salutary factors in Hispanic neighborhoods – found to be protective of Hispanic health (116-119, 121) – extending to members of other ethnic groups. These results may also be specific to New York City, where a large proportion of Hispanics and non-Hispanic black immigrants share Caribbean origins.

Separating US- from African- and Caribbean-born non-Hispanic blacks indicated that US-born blacks were uniquely harmed by residence in poor black neighborhoods. African- and Caribbean-born black women did experience increased preterm birth risks associated with African and Caribbean densities, respectively, but these elevations were much more modest. Black immigrants, who perceive less racism (186) and fewer structural barriers to success (177), may view black neighborhoods differently from their US-born counterparts. Many immigrant groups use enclaves as a stepping stone to assimilation with the white majority (60), and black immigrants may perceive their neighborhoods as temporary. In contrast, US-born blacks, with accumulated experiences of race-based limitations to geographic and economic mobility, may view black neighborhoods as a manifestation of racial oppression. In other words, historical context may color present-day geographic context to influence health.

These analyses were conducted using spatial measures of ethnic density that incorporated information beyond each woman's census tract (138) in an attempt to better characterize the geographic distribution of populations. While theoretically appealing, high correlations between the simple tract proportion of each ethnic group and the spatial measures indicated that the spatial component contributed little information. This may reflect large-scale segregation in New York City, such that large swathes of the city are characterized by high densities of a specific ethnic group; in this case, incorporating additional land area into the measure would simply incorporate redundant information (162). On the other hand, small-scale segregation may have been missed by the measures; for example, Grannis has reported that individuals with similar ethnic and racial identities tend to cluster along residential streets, suggesting that neighborhoods would be more appropriately defined along linear road networks and block faces (167). Where exact residential addresses are available, spatial approaches would enable such nuanced neighborhood definitions, but exact addresses were not available in the New York City birth records.

Several other limitations of the data are worth noting. First, the birth records contained no markers of maternal assimilation other than place of birth. Aim 2 and 3 results indicated that US- and foreign-born non-Hispanic black women differed importantly in their response to neighborhood environments. Measures of assimilation, particularly those related to ethnic identity and perceived racial oppression, would be useful for understanding why foreign-born black women respond favorably to residence in Hispanic neighborhoods or why the deleterious effects of black density appear to be most pronounced in US-born black women.

Second, while the birth records provided desirable power for these investigations, they are cross-sectional, with no information on repeat births to the same woman. Linked records identifying births to the same woman, or another source of longitudinal information, would allow the timing of neighborhood exposures to be identified; neighborhood changes across pregnancies could, for example, be used to explore shorter-term (i.e. pregnancy-specific) ethnic density effects. Optimally, ethnic density effects should be explored over the life-course and even across generations, particularly given potential interactions between neighborhood context and assimilation.

Third, the high rate of missingness of region-specific ethnic densities, due to census data suppression, hindered reliable estimation of their effects. Region-specific ethnic densities may be more meaningful for the social experience of a woman in a given neighborhood than densities based on broader ethnic definitions. The spatial patterning of births suggested, however, that self-segregation by region may, for example, make Hispanic density a reasonable proxy for Central American density when estimated in a Central American woman's neighborhood. Nonetheless, robust measures of region- or even country-specific densities might reveal additional variation of effects, and future research in this area might consider examining groups, such as Puerto Ricans and Chinese, with potentially sufficient numbers to support this level of nuance.

Finally, the study results pointed to the potential importance of the psychosocial environment, but available data did not include psychosocial variables. Data on social trust, intra- and inter-ethnic social ties (both within and across neighborhoods), behavioral norms, ethnic identities of immigrants, and perceptions of racism and limitations to geographic mobility, among other factors, would allow for exploration of the social mechanisms hypothesized here.

In these analyses, segregation most clearly benefited whites and harmed blacks, consistent with the long history of unequal resource distribution between blacks and whites that segregation has facilitated. Black and white neighborhoods may also have more potent or health-relevant meanings for their residents than neighborhoods comprised of more recently-arrived groups; residence in a white neighborhood may, for example, confer high social status even in the absence of high economic status. The more limited findings among Hispanics and Asians may, alternatively, reflect a counterbalancing of material deprivation with protective social aspects of ethnic enclaves. The importance of social factors is additionally suggested by the observed reduction in preterm birth risk experienced by non-Hispanic blacks living in Hispanic neighborhoods, and by the uniquely negative response of US-born blacks to black density. Examination of hypothesized social mechanisms using data with detailed psychosocial measures (especially those relating to racial identity, assimilation, social status, and social ties) could help to identify environments that buffer material hardship and elucidate the reasons for ethnically-based differences in health outcomes.

APPENDIX 3A

POPULATION COUNTS FOR CENSUS TRACTS CONTAINING NO BIRTHS

FIPS Code	Non-Hispanic Whites	Non-Hispanic Blacks	Hispanics	Asians	Total Population
36005000100	1,091	7,741	3,443	33	12,780
36005000500	0	0	0	0	0
36005004002	0	1	0	0	1
36005010500	3	185	247	1	439
36005017100	0	2	1	0	3
36005024900	22	37	84	0	144
36005027102	0	4	11	0	15
36005027600	5	0	2	0	7
36005031900	7	0	0	0	7
36005050400	2	0	3	0	5
36047008600	0	0	0	0	0
36047066600	0	1	0	0	1
36047070203	0	0	0	0	0
36047085200	0	0	0	0	0
36047107000	80	153	57	1	294
36047118000	0	0	0	0	0
36061000100	0	0	0	0	0
36061031100	6	12	1	0	19
36061031300	27	58	20	3	113
36061031702	2	1	0	0	3
36061031900	201	30	38	61	332
36081009900	0	0	0	0	0
36081042600	207	242	17	1	475
36081071600	20	1	0	0	28
36081079300	0	0	0	0	0
36081091602	22	0	0	0	22
36081091800	12	0	1	3	16
36081121100	0	0	0	0	0
36081131900	34	3	8	18	63
36081138502	0	0	0	0	0
36081162200	0	0	0	0	0
36085008900	0	0	0	0	0

APPENDIX 4A

AIM 1 FULLY ADJUSTED RISK DIFFERENCES

Ethnic Group	Model					
	Fully-adjusted*		Stratified: Richer Neighborhoods		Stratified: Poorer Neighborhoods	
	RD†	95% CI	RD†	95% CI	RD†	95% CI
Non-Hispanic white	-13.1	(-16.9, -9.3)	-7.1	(-13.6, -0.6)	-19.7	(-26.7, -12.6)
Non-Hispanic black	8.9	(5.0, 12.8)	5.3	(0.2, 10.5)	11.0	(5.5, 16.6)
Spanish Caribbean	-3.1	(-7.1, 0.9)	-1.6	(-6.9, 3.7)	-6.0	(-11.3, -0.6)
Central American	-6.2	(-12.7, 0.3)	0.2	(-6.3, 6.7)	-15.1	(-25.7, -4.6)
South American	3.1	(-4.0, 10.3)	3.0	(-4.0, 10.0)	1.8	(-16.6, 20.1)
East Asian	-3.2	(-8.3, 1.8)	-3.0	(-8.1, 2.1)	-3.3	(-13.7, 7.0)
South Asian	-7.8	(-15.9, 0.3)	-6.3	(-14.7, 2.0)	-17.4	(-38.8, 4.0)

*Fully-adjusted models included receipt of early prenatal care and pre-pregnancy weight

†RD=risk difference associated with living in a neighborhood with >25% own-group density; adjusted and stratified RDs were calculated for US-born women aged 20-34 who were high school-educated, were non-smokers, had 2-5 live births, received Medicaid, received early prenatal care, weighed 125-150 pounds pre-pregnancy, resided in a more stable and (for adjusted estimates) poorer neighborhood.

APPENDIX 4B

AIM 1 RISK DIFFERENCES CONTROLLING FOR NON-HISPANIC BLACK DENSITY

ETHNIC GROUP	MODEL					
	Fully-adjusted		Stratified: Richer Neighborhoods		Stratified: Poorer Neighborhoods	
	RD*	95% CI	RD*	95% CI	RD*	95% CI
Non-Hispanic white	-14.3	(-18.4, -10.1)	-8.8	(-16.1, -1.6)	-17.1	(-23.7, -10.6)
Spanish Caribbean	-2.1	(-6.1, 1.9)	-1.9	(-7.3, 3.5)	-3.7	(-9.1, 1.7)
Central American	-1.9	(-7.0, 3.3)	2.8	(-3.5, 9.0)	-8.3	(-17.1, 0.4)
South American	2.7	(-3.5, 8.9)	3.6	(-3.1, 10.4)	-2.7	(-19.6, 14.1)
East Asian	-2.6	(-7.5, 2.2)	-2.8	(-7.9, 2.2)	-0.8	(-10.5, 9.0)
South Asian	-5.2	(-12.2, 1.8)	-3.9	(-11, 3.3)	-12.5	(-30.0, 5.0)

*RD=risk difference associated with living in a neighborhood with >25% own-group density; adjusted and stratified RDs were calculated for US-born women aged 20-34 who were high-school educated, had 2-5 live births, were nonsmokers, received Medicaid, and resided in a more stable and (for adjusted estimates) poorer neighborhood that was <=25% non-Hispanic black

APPENDIX 4C

RESULTS OF AIM 1 SENSITIVITY ANALYSES

ALTERNATE POPULATION/VARIABLE SPECIFICATION & ETHNIC GROUP		MODEL							
		Crude		Adjusted		Stratified: Richer Neighborhoods		Stratified: Poorer Neighborhoods	
		RD*	(95% CI)	RD*	(95% CI)	RD*	(95% CI)	RD*	(95% CI)
Exposure Dichotomized at 20%	Non-Hispanic white	-20.0	(-24.3, -15.7)	-17.3	(-21.3, -13.4)	-11.9	(-19.2, -4.7)	-18.6	(-24.3, -13)
	Non-Hispanic black	10.8	(6.9, 14.8)	6.0	(2.1, 10.0)	5.1	(0.3, 9.9)	7.1	(1.0, 13.2)
	Spanish Caribbean	-2.4	(-6.8, 1.9)	-2.4	(-7.0, 2.1)	-1.8	(-7.4, 3.9)	-5.1	(-11.8, 1.6)
	Central American	-2.6	(-7.9, 2.7)	-1.6	(-7.4, 4.2)	2.8	(-3.9, 9.4)	-11.0	(-21.2, -0.8)
	South American	2.0	(-3.6, 7.7)	5.0	(-1.5, 11.4)	4.5	(-2.6, 11.6)	5.1	(-12.1, 22.3)
	East Asian	-2.7	(-6.5, 1.1)	-2.4	(-7.1, 2.3)	-1.0	(-5.7, 3.7)	-6.5	(-16.6, 3.6)
	South Asian	-8.8	(-14.9, -2.8)	-5.8	(-12.0, 0.4)	-3.5	(-9.7, 2.7)	-19.2	(-36.4, -2.1)
Spontaneous Preterm Birth	Non-Hispanic white	-15.5	(-19.1, -12.0)	-13.8	(-16.9, -10.7)	-7.9	(-13.5, -2.4)	-18.8	(-23.9, -13.8)
	Non-Hispanic black	8.4	(5.1, 11.7)	6.2	(2.9, 9.4)	3.6	(-0.6, 7.8)	8.4	(3.9, 13.0)
	Spanish Caribbean	-3.7	(-7.2, -0.2)	-3.3	(-7.2, 0.6)	-1.8	(-6.8, 3.2)	-5.6	(-11.1, -0.1)
	Central American	-0.4	(-4.8, 4.1)	0.0	(-5.1, 5.0)	5.9	(-0.2, 12.1)	-8.0	(-16.8, 0.8)
	South American	4.2	(-0.5, 8.8)	6.3	(0.7, 11.9)	6.5	(0.0, 13.1)	5.6	(-8.2, 19.4)
	East Asian	-2.3	(-5.4, 0.8)	-1.5	(-5.3, 2.2)	-1.6	(-5.8, 2.5)	-1.6	(-8.9, 5.6)
	South Asian	-3.4	(-9.2, 2.3)	-1.9	(-8.0, 4.2)	-0.5	(-6.3, 5.3)	-11.3	(-28.0, 5.5)
Primiparous Women Only	Non-Hispanic white	-9.7	(-14.8, -4.5)	-10.1	(-16.0, -4.2)	-5.2	(-15.0, 4.5)	-11.0	(-20.3, -1.7)
	Non-Hispanic black	8.7	(4.1, 13.3)	8.8	(3.8, 13.8)	8.4	(1.8, 15.0)	9.2	(2.1, 16.3)
	Spanish Caribbean	-1.7	(-7.1, 3.7)	1.4	(-4.5, 7.4)	0.9	(-7.3, 9.1)	-0.1	(-8.3, 8.2)
	central American	-2.6	(-9.4, 4.3)	-4.2	(-12.7, 4.2)	-1.3	(-12.0, 9.4)	-9.0	(-21.1, 3.0)
	South American	0.3	(-7.6, 8.1)	1.0	(-7.5, 9.6)	1.0	(-9.1, 11.1)	1.5	(-17.4, 20.4)
	East Asian	-6.0	(-10.9, -1.1)	-7.2	(-13.8, -0.6)	-2.3	(-9.2, 4.6)	-16.5	(-29.7, -3.3)
	South Asian	-6.9	(-16.9, 3.0)	-4.8	(-14.6, 4.9)	-3.5	(-13.7, 6.7)	-12.9	(-41.4, 15.6)

*RD=risk difference; adjusted and stratified RDs were calculated for US-born women aged 20-34 who were high-school educated, had 2-5 previous live births, were nonsmokers, received Medicaid, and resided in a more stable and (for adjusted estimates) poorer neighborhood.

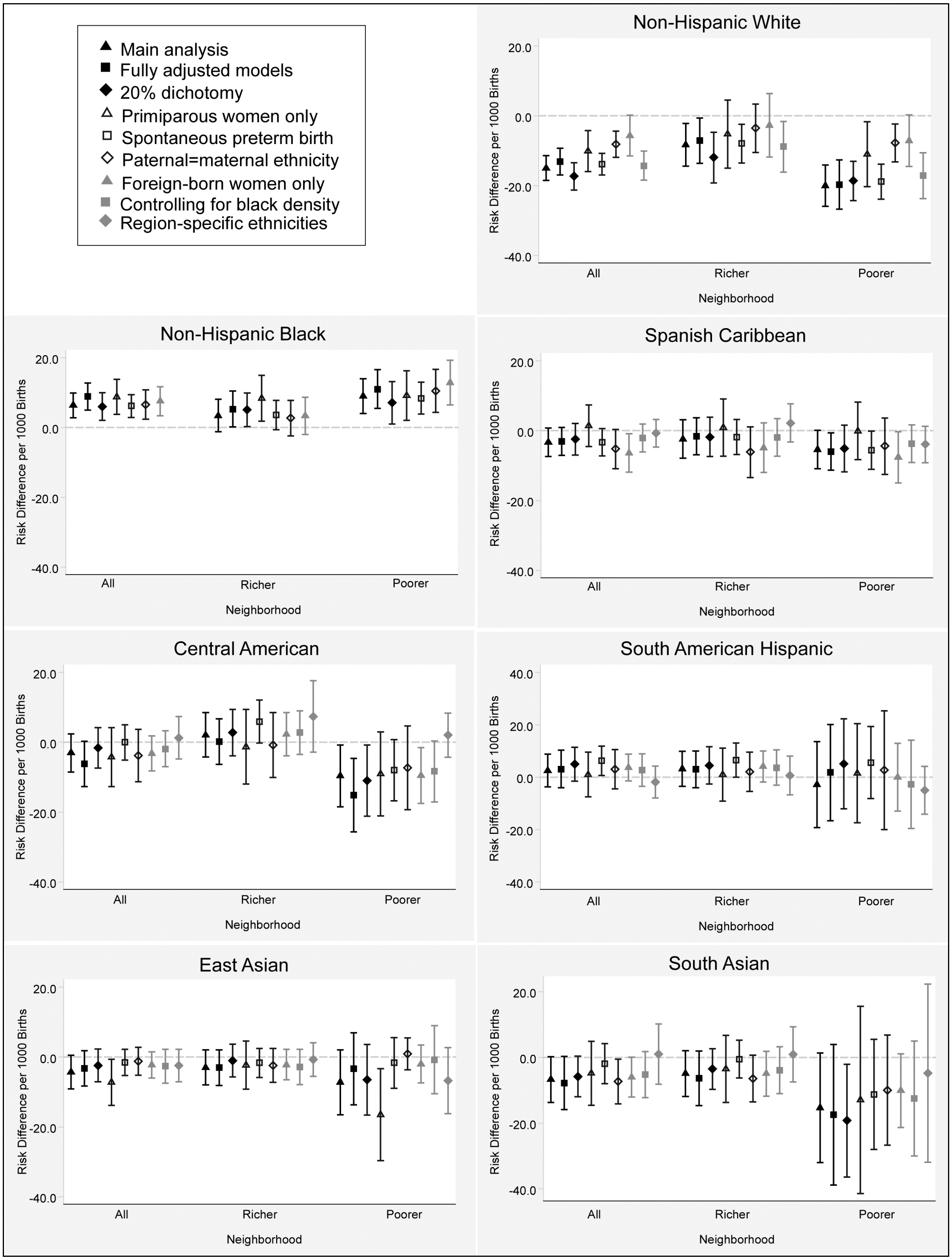
APPENDIX 4C, continued

Alternate Population/Variable Specification & Ethnic Group		Model							
		Crude		Adjusted		Stratified: Richer Neighborhoods		Stratified: Poorer Neighborhoods	
		RD*	(95% CI)	RD*	(95% CI)	RD*	(95% CI)	RD*	(95% CI)
Paternal = Maternal Ethnicity	Non-Hispanic white	-5.6	(-9.8, -1.4)	-8.1	(-11.9, -4.4)	-3.5	(-10.5, 3.4)	-7.7	(-13.2, -2.3)
	Non-Hispanic black	9.5	(5.2, 13.7)	6.6	(2.4, 10.8)	2.7	(-2.4, 7.8)	10.5	(4.4, 16.7)
	Spanish Caribbean	-5.1	(-10.3, 0.0)	-5.2	(-10.9, 0.4)	-6.1	(-13.4, 1.1)	-4.4	(-12.5, 3.6)
	Central American	-3.5	(-9.3, 2.3)	-3.8	(-11.3, 3.7)	-0.8	(-10.1, 8.5)	-7.3	(-19.3, 4.7)
	South American	1.6	(-5.1, 8.3)	3.0	(-4.5, 10.5)	2.1	(-5.4, 9.6)	2.7	(-20.0, 25.3)
	East Asian	-0.6	(-4.4, 3.2)	-1.2	(-5.2, 2.8)	-2.4	(-7.2, 2.5)	0.9	(-3.6, 5.5)
	South Asian	-10.5	(-17.7, -3.3)	-7.3	(-14.1, -0.5)	-6.4	(-13.5, 0.7)	-10.0	(-26.7, 6.8)
Foreign-born Women Only	Non-Hispanic white	-9.5	(-14.9, -4.1)	-5.7	(-11.5, 0.2)	-2.7	(-11.8, 6.4)	-7.1	(-14.5, 0.3)
	Non-Hispanic black	11.3	(6.4, 16.2)	7.6	(3.4, 11.7)	3.4	(-2.0, 8.7)	12.9	(6.5, 19.3)
	Spanish Caribbean	-6.3	(-11.9, -0.7)	-6.4	(-11.9, -0.9)	-4.9	(-12.0, 2.2)	-7.6	(-15.0, -0.3)
	Central American	-3.7	(-8.6, 1.2)	-3.2	(-8.2, 1.8)	2.3	(-3.9, 8.5)	-9.5	(-17.5, -1.5)
	South American	2.9	(-2.4, 8.2)	3.7	(-1.4, 8.8)	4.1	(-1.8, 10.0)	0.0	(-12.9, 12.9)
	East Asian	-2.1	(-5.8, 1.5)	-2.2	(-6.0, 1.5)	-2.2	(-6.5, 2.2)	-2.0	(-7.4, 3.5)
	South Asian	-9.0	(-15.7, -2.2)	-6.0	(-12.1, 0.1)	-4.9	(-11.8, 1.9)	-10.1	(-21.3, 1.1)

*RD=risk difference; adjusted and stratified RDs were calculated for US-born women aged 20-34 who were high-school educated, had 2-5 previous live births, were nonsmokers, received Medicaid, and resided in a more stable and (for adjusted estimates) poorer neighborhood

APPENDIX 4D

GRAPHICAL DISPLAY OF AIM 1 SUPPLEMENTAL RESULTS



APPENDIX 4E

AIM 1: DISTRIBUTION OF BIRTHS IN EACH OF SEVEN ETHNIC GROUPS ACROSS NEIGHBORHOOD DEPRIVATION, ETHNIC DENSITY, AND COVARIATE LEVELS

ETHNIC GROUP & COVARIATE LEVEL	NEIGHBORHOOD DEPRIVATION & ETHNIC DENSITY STRATUM			
	Richer		Poorer	
	<=25%	>25%	<=25%	>25%
Non-Hispanic White				
Total births	7,755	190,281	16,055	23,403
Maternal age (years)				
<20	421	2,909	1,275	426
20-34	5,711	133,117	12,021	19,448
35+	1,623	54,255	2,759	3,529
Maternal education				
age<20&noHS	249	1,455	830	168
age>=20&noHS	951	8,342	3,051	3,180
HS	2,812	55,135	5,959	16,381
HS+	1,631	34,746	2,815	1,806
College+	2,002	89,105	3,185	1,566
Maternal nativity				
US-born	4,544	131,169	9,777	17,827
Foreign-born	3,170	58,525	6,139	5,459
Number of births				
1	3,707	96,840	7,139	7,031
2-5	3,920	90,144	8,464	13,313
6+	128	3,276	450	3,045
Prepregnancy weight (pounds)				
<125	1,822	54,825	3,782	7,101
125-150	2,873	78,803	6,019	8,633
>150	2,289	42,850	4,724	5,396
Tobacco use during current pregnancy				
Nonsmoker	7,305	183,001	15,002	23,090
Smoker	418	6,755	991	270
Late or no prenatal care				
No	5,573	153,356	11,102	14,755
Yes	1,343	16,529	3,051	4,835
Method of payment for delivery				
Private insurance	4,152	148,721	6,269	10,939
Medicaid	3,194	32,960	9,101	11,303
Self pay	343	7,834	584	1,080

APPENDIX 4E, continued

Ethnic Group & Covariate Level	Neighborhood Deprivation & Ethnic Density Stratum			
	Richer		Poorer	
	<=25%	>25%	<=25%	>25%
Non-Hispanic Black				
Total births	20,611	72,476	20,045	143,514
Maternal age (years)				
<20	1,751	5,814	2,246	17,900
20-34	14,407	51,353	14,715	102,710
35+	4,453	15,309	3,084	22,904
Maternal education				
age<20&noHS	1,181	3,379	1,549	12,020
age>=20&noHS	2,380	8,121	4,827	30,753
HS	6,766	25,411	7,219	53,892
HS+	5,152	21,722	4,315	32,445
College+	4,878	13,013	1,819	11,964
Maternal nativity				
US-born	10,166	31,560	12,183	88,047
Foreign-born	10,266	40,540	7,653	54,495
Number of births				
1	10,161	32,233	7,873	57,643
2-5	10,274	39,580	11,707	82,695
6+	175	662	462	3,170
Prepregnancy weight (pounds)				
<125	4,393	11,675	3,763	24,944
125-150	7,417	24,971	6,676	47,542
>150	6,930	30,614	7,935	59,124
Tobacco use during current pregnancy				
Nonsmoker	19,729	70,055	18,471	132,119
Smoker	772	1,980	1,450	10,484
Late or no prenatal care				
No	14,251	50,468	12,862	92,052
Yes	3,996	14,079	4,650	33,833
Method of payment for delivery				
Private insurance	9,976	31,899	5,639	39,249
Medicaid	9,621	36,313	13,576	95,685
Self pay	771	2,436	639	5,249

APPENDIX 4E, continued

Ethnic Group & Covariate Level	Neighborhood Deprivation & Ethnic Density Stratum			
	Richer		Poorer	
	<=25%	>25%	<=25%	>25%
Spanish Caribbean				
Total births	21,028	20,582	9,928	129,983
Maternal age (years)				
<20	1,895	2,199	1,638	18,545
20-34	15,471	15,497	7,255	96,353
35+	3,662	2,886	1,035	15,085
Maternal education				
age<20&noHS	1,292	1,515	1,239	14,158
age>=20&noHS	3,054	3,970	3,169	38,903
HS	6,365	6,938	3,101	42,326
HS+	6,175	5,466	1,792	24,411
College+	3,990	2,517	525	8,471
Maternal nativity				
US-born	14,125	11,752	5,693	54,520
Foreign-born	6,846	8,767	4,206	75,114
Number of births				
1	9,901	9,252	4,017	52,591
2-5	11,008	11,208	5,735	76,135
6+	119	122	176	1,256
Prepregnancy weight (pounds)				
<125	5,486	5,057	2,569	33,607
125-150	8,187	7,817	3,564	50,400
>150	6,054	6,162	3,096	36,663
Tobacco use during current pregnancy				
Nonsmoker	20,035	19,786	9,124	123,009
Smoker	894	703	748	6,335
Late or no prenatal care				
No	15,934	15,053	6,744	88,242
Yes	3,089	3,446	2,193	26,047
Method of payment for delivery				
Private insurance	11,540	8,581	2,071	25,574
Medicaid	8,677	11,375	7,434	100,309
Self pay	671	502	286	3,384

APPENDIX 4E, continued

ETHNIC GROUP & COVARIATE LEVEL	NEIGHBORHOOD DEPRIVATION & ETHNIC DENSITY STRATUM			
	Richer		Poorer	
	<=25%	>25%	<=25%	>25%
Central American				
Total births	13,140	11,412	5,795	42,743
Maternal age (years)				
<20	1,299	1,192	626	5,231
20-34	10,326	9,196	4,460	33,952
35+	1,515	1,024	709	3,560
Maternal education				
age<20&noHS	966	909	480	4,176
age>=20&noHS	5,444	5,522	2,402	23,296
HS	3,855	3,445	1,743	11,222
HS+	1,414	814	796	2,357
College+	1,281	430	292	893
Maternal nativity				
US-born	1,078	485	464	1,658
Foreign-born	12,044	10,914	5,327	41,066
Number of births				
1	5,883	4,977	2,400	16,823
2-5	7,205	6,392	3,346	25,594
6+	52	43	49	326
Prepregnancy weight (pounds)				
<125	4,110	3,425	1,474	14,246
125-150	5,071	4,116	2,171	16,034
>150	2,259	1,912	1,418	7,784
Tobacco use during current pregnancy				
Nonsmoker	13,006	11,345	5,724	42,491
Smoker	71	32	54	147
Late or no prenatal care				
No	9,271	7,309	3,759	28,453
Yes	2,764	2,902	1,501	10,613
Method of payment for delivery				
Private insurance	2,675	1,327	830	2,734
Medicaid	9,885	9,451	4,634	38,212
Self pay	503	558	212	1,553

APPENDIX 4E, continued

ETHNIC GROUP & COVARIATE LEVEL	NEIGHBORHOOD DEPRIVATION & ETHNIC DENSITY STRATUM			
	Richer		Poorer	
	<=25%	>25%	<=25%	>25%
South American				
Total births	10,295	12,463	1,131	19,432
Maternal age (years)				
<20	442	708	71	1,412
20-34	7,416	9,101	838	14,557
35+	2,437	2,654	222	3,463
Maternal education				
age<20&noHS	260	450	44	909
age>=20&noHS	1,462	2,678	266	6,213
HS	3,386	4,977	487	7,117
HS+	2,506	2,639	207	3,264
College+	2,538	1,475	107	1,536
Maternal nativity				
US-born	1,462	1,084	133	1,437
Foreign-born	8,822	11,374	996	17,988
Number of births				
1	5,086	5,718	438	8,032
2=5	5,169	6,706	641	11,280
6+	39	39	51	120
Prepregnancy weight (pounds)				
<125	3,123	3,295	329	5,443
125-150	4,133	4,638	436	7,745
>150	1,885	2,323	249	3,456
Tobacco use during current pregnancy				
Nonsmoker	10,188	12,339	1,115	19,276
Smoker	76	75	10	95
Late or no prenatal care				
No	7,575	8,088	780	12,776
Yes	1,716	2,882	234	4,621
Method of payment for delivery				
Private insurance	4,687	3,293	289	2,819
Medicaid	5,148	8,561	794	15,783
Self pay	391	500	35	720

APPENDIX 4E, continued

Ethnic Group & Covariate Level	Neighborhood Deprivation & Ethnic Density Stratum			
	Richer		Poorer	
	<=25%	>25%	<=25%	>25%
East Asian				
Total births	18,915	13,513	5,656	15,781
Maternal age (years)				
<20	88	97	103	160
20-34	13,655	10,314	4,609	13,257
35+	5,172	3,102	944	2,364
Maternal education				
age<20&noHS	48	54	59	86
age>=20&noHS	2,359	2,476	1,870	6,569
HS	4,988	4,883	2,207	6,526
HS+	2,892	1,973	567	963
College+	8,414	3,918	809	1,203
Maternal nativity				
US-born	1,661	420	193	215
Foreign-born	17,193	13,062	5,439	15,499
Number of births				
1	10,873	6,933	2,956	8,057
2-5	8,038	6,578	2,695	7,719
6+	4	2	5	5
Prepregnancy weight (pounds)				
<125	11,817	8,183	3,560	10,258
125-150	5,176	3,815	1,454	3,948
>150	953	646	289	544
Tobacco use during current pregnancy				
Nonsmoker	18,732	13,441	5,609	15,693
Smoker	126	40	32	43
Late or no prenatal care				
No	14,990	10,218	4,235	11,749
Yes	2,503	2,266	987	2,841
Method of payment for delivery				
Private insurance	11,393	5,586	1,520	2,557
Medicaid	6,452	7,013	3,849	12,340
Self pay	880	776	201	682

APPENDIX 4E, continued

Ethnic Group & Covariate Level	Neighborhood Deprivation & Ethnic Density Stratum			
	Richer		Poorer	
	<=25%	>25%	<=25%	>25%
South Asian				
Total births	21,112	10,699	7,946	2,098
Maternal age (years)				
<20	386	197	252	39
20-34	17,284	9,014	6,501	1,815
35+	3,442	1,488	1,193	244
Maternal education				
age<20&noHS	205	88	153	14
age>=20&noHS	3,967	1,521	2,205	363
HS	7,241	4,216	3,079	792
HS+	3,472	1,787	1,130	339
College+	5,673	2,609	1,151	409
Maternal nativity				
US-born	609	124	198	19
Foreign-born	20,469	10,568	7,729	2,077
Number of births				
1	9,805	4,740	3,380	920
2-5	11,237	5,922	4,510	1,174
6+	70	37	56	4
Prepregnancy weight (pounds)				
<125	7,348	3,643	2,727	659
125-150	7,616	3,506	2,840	603
>150	3,143	1,552	1,212	280
Tobacco use during current pregnancy				
Nonsmoker	21,012	10,671	7,893	2,091
Smoker	49	11	31	0
Late or no prenatal care				
No	14,451	7,099	5,196	1,229
Yes	4,882	2,561	1,999	585
Method of payment for delivery				
Private insurance	8,929	3,477	2,108	481
Medicaid	11,288	6,669	5,509	1,494
Self pay	784	503	274	99

APPENDIX 4F

AIM 1 RESULTS WITH REGION-SPECIFIC ETHNIC DENSITIES

HANDLING OF SUPPRESSED TRACTS ETHNIC GROUP	MODEL							
	Crude		Adjusted		Stratified: Richer Neighborhoods		Stratified: Poorer Neighborhoods	
	RD	(95% CI)	RD	(95% CI)	RD	(95% CI)	RD	(95% CI)
Suppressed tracts excluded								
Spanish Caribbean	0.0	(-3.7, 3.7)	-1.2	(-5.2, 2.8)	1.8	(-3.6, 7.3)	-4.3	(-9.5, 1.0)
Central American	1.0	(-5.2, 7.1)	2.2	(-4.0, 8.3)	6.9	(-4.6, 18.3)	2.8	(-3.5, 9.1)
South American	-2.3	(-7.7, 3.0)	-2.6	(-8.4, 3.3)	-0.1	(-7.2, 7.1)	-5.5	(-14.2, 3.2)
East Asian	-1.3	(-5.1, 2.6)	-1.5	(-5.9, 2.9)	-0.1	(-4.8, 4.6)	-4.2	(-11.9, 3.4)
South Asian	1.7	(-8.2, 11.7)	1.3	(-7.3, 9.9)	1.4	(-6.6, 9.3)	-3.5	(-30.0, 23.0)
Suppressed exposures set to zero								
Spanish Caribbean	0.6	(-3.0, 4.1)	-0.7	(-4.7, 3.2)	2.2	(-3.2, 7.7)	-3.9	(-9.2, 1.3)
Central American	0.4	(-5.6, 6.5)	1.3	(-4.8, 7.4)	7.4	(-2.8, 17.7)	2.1	(-4.3, 8.4)
South American	-2.1	(-7.2, 3.1)	-1.9	(-8.0, 4.2)	0.7	(-6.7, 8.1)	-5.0	(-14.1, 4.1)
East Asian	-2.2	(-5.8, 1.5)	-2.4	(-7.1, 2.2)	-0.7	(-5.5, 4.1)	-6.7	(-16.2, 2.7)
South Asian	0.2	(-9.6, 10.0)	1.0	(-8.2, 10.2)	0.9	(-7.5, 9.3)	-4.8	(-31.9, 22.3)

*RD=risk difference; adjusted and stratified RDs were calculated for US-born women aged 20-34 who were high-school educated, had 2-5 previous live births, were nonsmokers, received Medicaid, and resided in Brooklyn in a more stable and (for adjusted estimates) poorer neighborhood

APPENDIX 5A

AIM 2 COVARIATE DISTRIBUTIONS BY NEIGHBORHOOD TYPE

COVARIATE	NEIGHBORHOOD TYPE											
	High Hispanic Density*			High Asian Density*			High White Density*			High Black Density*		
	N	%	% PTB	N	%	% PTB	N	%	% PTB	N	%	% PTB
Age (years)												
<20	3,073	12%	11%	2,042	8%	9%	2,299	9%	10%	2,408	9%	10%
20-34	18,724	73%	10%	18,461	72%	10%	17,600	69%	9%	18,187	72%	10%
35+	3,784	15%	13%	5,047	20%	12%	5,546	22%	12%	4,843	19%	13%
Maternal education (years)												
<12, age<20	2,165	9%	11%	1,319	5%	10%	1,531	6%	10%	1,421	6%	11%
<12, age>=20	7,000	28%	11%	3,448	14%	12%	2,796	11%	12%	3,111	12%	12%
12	8,999	36%	10%	9,266	37%	10%	7,958	32%	11%	9,435	38%	11%
13-15	5,151	20%	10%	6,400	25%	9%	6,908	28%	10%	7,423	30%	10%
16+	1,863	7%	9%	4,775	19%	9%	5,900	24%	8%	3,745	15%	10%
Previous births												
1	9,456	37%	10%	11,897	47%	10%	12,230	48%	10%	11,086	44%	10%
2-5	15,443	60%	11%	13,429	53%	10%	12,991	51%	10%	14,065	55%	10%
6+	677	3%	19%	223	1%	17%	223	1%	18%	287	1%	17%
Prepreg. weight (pounds)												
<125	4,559	20%	12%	5,202	23%	10%	4,849	21%	11%	4,076	17%	11%
125-150	8,605	37%	10%	8,746	38%	10%	9,169	39%	10%	8,434	36%	10%
>150	10,169	44%	9%	9,091	39%	10%	9,215	40%	9%	11,200	47%	10%
Tobacco use												
Nonsmoker	23,334	92%	10%	24,430	96%	10%	24,248	96%	10%	24,296	96%	10%
Smoker	2,132	8%	18%	975	4%	18%	1,046	4%	16%	982	4%	17%
Late or no prenatal care												
No	16,061	73%	10%	17,691	77%	9%	17,602	78%	10%	17,690	78%	10%
Yes	6,017	27%	11%	5,236	23%	10%	4,914	22%	10%	5,116	22%	11%

*"High density" refers to >90th percentile as experienced by black mothers in the birth records. The 90th percentile corresponds to neighborhoods that are >61.9% Hispanic, >8.1% Asian, >23.6% non-Hispanic white, and >88.9% non-Hispanic black.

APPENDIX 5A, continued

COVARIATE	NEIGHBORHOOD TYPE											
	High Hispanic Density*			High Asian Density*			High White Density*			High Black Density*		
	N	%	% PTB	N	%	% PTB	N	%	% PTB	N	%	% PTB
Payment for delivery												
Private ins.	6,444	25%	9%	10,853	43%	9%	12,171	49%	9%	10,043	41%	10%
Medicaid	17,969	71%	11%	13,387	53%	10%	11,882	47%	11%	13,728	56%	11%
Self pay	981	4%	15%	994	4%	16%	968	4%	14%	920	4%	16%
Nativity												
US-born	16,434	65%	12%	11,520	45%	11%	13,933	55%	11%	12,649	50%	11%
Foreign-born	8,912	35%	8%	13,856	55%	10%	11,293	45%	9%	12,688	50%	10%
Residential stability												
Less stable	12,272	48%	10%	16,089	63%	10%	14,804	58%	10%	1,223	5%	11%
More stable	13,309	52%	11%	9,461	37%	11%	10,640	42%	10%	24,215	95%	10%
Neighborhood deprivation												
Richer	453	2%	9%	18,391	72%	10%	21,632	85%	10%	17,723	70%	10%
Poorer	25,128	98%	11%	7,159	28%	11%	3,812	15%	10%	7,715	30%	12%

*"High density" refers to >90th percentile as experienced by black mothers in the birth records. The 90th percentile corresponds to neighborhoods that are >61.9% Hispanic, >8.1% Asian, >23.6% non-Hispanic white, and >88.9% non-Hispanic black.

APPENDIX 5B

AIM 2 FULLY ADJUSTED RISK DIFFERENCES

Ethnic Density Exposure	Model					
	Fully Adjusted*		Stratified: US-born		Stratified: Foreign-born	
	RD[†]	(95% CI)	RD[†]	(95% CI)	RD[†]	(95% CI)
Hispanic	-5.5	(-12.6, 1.7)	3.8	(-5.3, 12.9)	-17.4	(-27.4, -7.4)
Asian	0.0	(-2.4, 2.4)	-0.3	(-3.6, 3.0)	0.5	(-2.7, 3.7)
Non-Hispanic black	5.2	(-2.6, 12.9)	11.1	(1.0, 21.2)	-2.4	(-12.9, 8.1)
5^{th} to 25^{th} percentile non-Hispanic black	7.5	(3.1, 11.8)	7.5	(1.9, 13.2)	5.0	(-0.7, 10.7)

*Fully-adjusted models included receipt of early prenatal care and pre-pregnancy weight

[†] RD=risk difference corresponding to a change from 10^{th} to 90^{th} percentiles of ethnic density. Fully adjusted and stratified risk differences were calculated for women aged 20-34 who were high-school educated, had 2-5 previous live births, weighed between 125 and 150 pounds pre-pregnancy, were nonsmokers, had early prenatal care, were on Medicaid, and resided in a more stable, poorer, and white neighborhood. Adjusted (combined nativity) risk differences were calculated for US-born women.

APPENDIX 5C

RESULTS OF AIM 2 SENSITIVITY ANALYSES

RESTRICTION & ETHNIC DENSITY EXPOSURE	MODEL: Adjusted		Stratified: US-born		Stratified: Foreign-born	
	RD*	(95% CI)	RD*	(95% CI)	RD*	(95% CI)
Spontaneous PTB Only						
Hispanic	-7.8	(-14.2, -1.3)	-4.2	(-13.2, 4.8)	-12.1	(-20.0,-4.2)
Asian	-0.6	(-2.7, 1.4)	-1.2	(-4.4, 1.9)	0.1	(-2.3, 2.6)
Non-Hispanic black	1.1	(-5.8, 8.0)	2.6	(-7.4, 12.6)	-0.6	(-9.1, 7.9)
5th to 25th percentile Non-Hispanic black	5.4	(1.5, 9.3)	5.7	(0.2, 11.2)	3.4	(-1.2, 8.0)
Primips Only						
Hispanic	-4.6	(-13.9, 4.7)	0.7	(-12.3, 13.7)	-12.6	(-26.6, 1.5)
Asian	2.2	(-0.9, 5.3)	1.4	(-3.4, 6.3)	2.9	(-0.9, 6.7)
Non-Hispanic black	6.8	(-3.6, 17.3)	10.9	(-4.1, 26.0)	2.6	(-12.0, 17.1)
5th to 25th percentile Non-Hispanic black	9.2	(3.5, 14.9)	11.0	(3.0, 19.0)	5.6	(-2.4, 13.9)
Very Preterm						
Hispanic	-1.1	(-4.6, 2.4)	3.1	(-1.5, 7.7)	-5.7	(-10.4, -1.1)
Asian	-1.0	(-2.2, 0.2)	-0.6	(-2.1, 0.8)	-1.2	(-2.9, 0.4)
Non-Hispanic black	1.9	(-2.0, 5.7)	6.2	(0.9, 11.5)	-2.6	(-7.5, 2.4)
5th to 25th percentile non-Hispanic black	2.8	(0.6, 5.0)	3.3	(0.5, 6.1)	1.2	(-1.5, 3.9)

* RD=risk difference corresponding to a change from 10th to 90th percentiles of ethnic density. Adjusted and stratified risk differences were calculated for women aged 20-34 who were high school educated, were nonsmokers, were on Medicaid, and resided in a more stable, poorer, and white neighborhood. Adjusted (combined nativity) risk differences were calculated for US-born women. Spontaneous PTB and very preterm risk differences were calculated for women with 2-5 previous live births.

APPENDIX 6A

AIM 3 FULLY ADJUSTED RISK DIFFERENCES

Ethnic Density Exposure	Model					
	Fully Adjusted*		Stratified: Richer neighborhoods		Stratified: Poorer neighborhoods	
	RD†	(95% CI)	RD†	(95% CI)	RD†	(95% CI)
African-born	6.1	(2.9, 9.4)	2.2	(-3.5, 7.8)	8.4	(3.7, 13.1)
Caribbean-born	0.0	(-5.1, 5.1)	-2.3	(-9.7, 5.1)	2.2	(-4.6, 8.6)
US-born	10.2	(5.0, 15.3)	2.3	(-7.1, 11.7)	12.6	(6.2, 19.0)

*Fully-adjusted models included receipt of early prenatal care and pre-pregnancy weight

† RD=risk difference corresponding to a change from 10th to 90th percentiles of ethnic/immigrant density. Fully adjusted and stratified risk differences were calculated for women aged 20-34 who were high-school educated, had 2-5 previous live births, weighed between 125 and 150 pounds pre-pregnancy, were nonsmokers, had early prenatal care, were on Medicaid, and resided in a more stable neighborhood and (for adjusted estimates) poorer neighborhood.

APPENDIX 6B

RESULTS OF AIM 3 SENSITIVITY ANALYSES

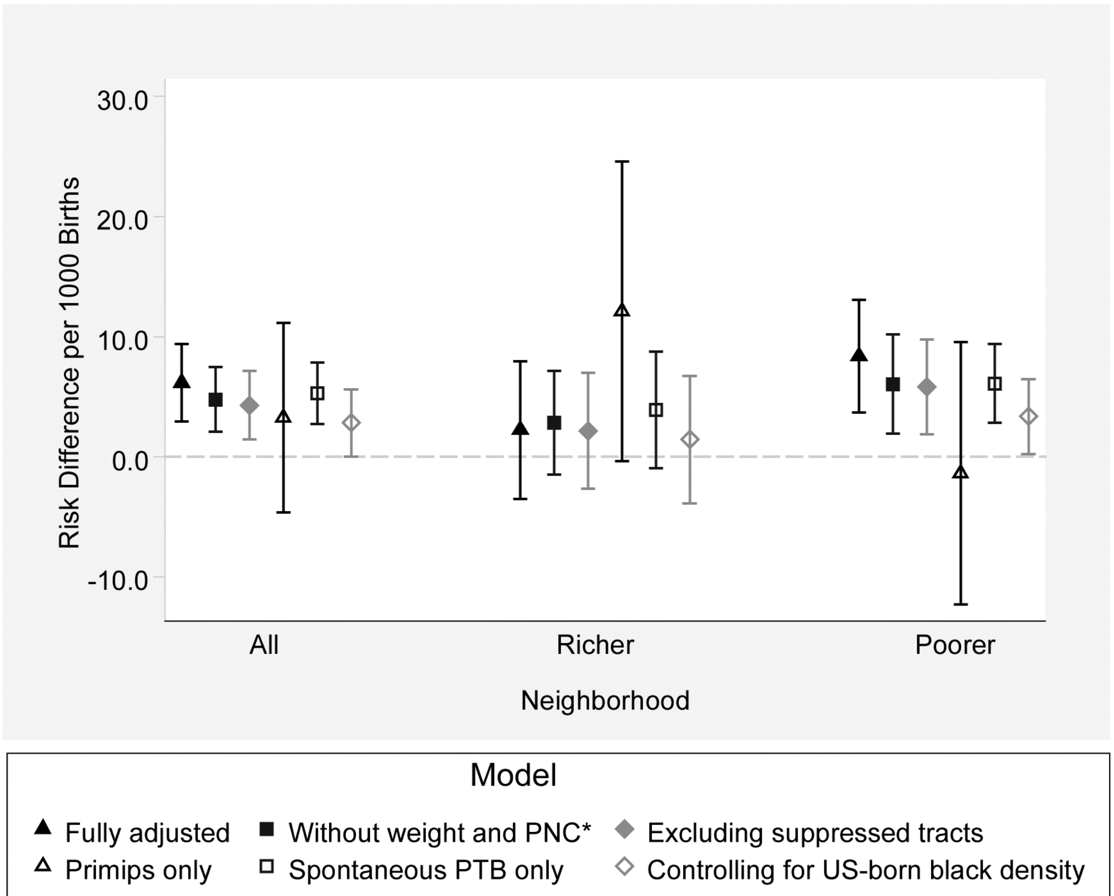
ANALYSIS & ETHNIC/IMMIGRANT GROUP	MODEL					
	Adjusted		Stratified: Richer neighborhood		Stratified: Poorer neighborhood	
	RD	(95% CI)	RD	(95% CI)	RD	(95% CI)
Controlling for US-born Black Density						
African-born	2.8	(0.0, 5.6)	1.4	(-3.9, 6.7)	3.3	(0.2, 6.5)
Caribbean-born	2.9	(-3.8, 9.6)	-2.3	(-13.0, 8.4)	5.8	(-2.6, 14.2)
Primips Only						
African-born	3.3	(-4.6, 11.1)	12.1	(-0.3, 24.6)	-1.4	(-12.3, 9.5)
Caribbean-born	8.7	(0.3, 17.0)	6.2	(-5.9, 18.2)	11.2	(0.3, 22.1)
US-born	10.1	(2.9, 17.3)	-3.4	(-14.4, 7.6)	15.4	(6.0, 24.8)
Spontaneous PTB						
African-born	5.3	(2.7, 7.8)	3.9	(-0.8 8.5)	6.1	(2.8, 9.4)
Caribbean-born	1.7	(-2.6, 6.0)	0.7	(-5.3, 6.6)	2.6	(-2.5, 7.7)
US-born	10.8	(6.4, 15.2)	-1.8	(-10.0, 6.4)	15.0	(9.7, 20.4)
Excluding Suppressed Tracts						
African-born	4.3	(1.4, 7.1)	2.2	(-2.6, 7.0)	5.8	(1.9, 9.7)
Caribbean-born	1.7	(-3.8, 7.1)	-2.6	(-10.9, 5.6)	4.3	(-1.9, 10.5)
US-born	8.2	(2.6, 13.8)	-9.0	(-18.7, 0.7)	15.4	(8.9, 21.9)
Excluding South Americans						
Caribbean-born	3.3	(-2.4, 9.0)	0.9	(-6.9, 8.7)	4.9	(-1.8, 11.6)

* Risk differences correspond to a change from 10^{th} to 90^{th} percentiles of ethnic density. Adjusted and stratified risk differences were calculated for women aged 20-34 who were high school-educated, had 2-5 previous live births, were nonsmokers, were on Medicaid, and resided in a more stable neighborhood. Adjusted risk differences were calculated for poorer neighborhoods.

APPENDIX 6C

GRAPHICAL DISPLAY OF AIM 3 SUPPLEMENTAL RESULTS

AFRICAN-BORN NON-HISPANIC BLACK WOMEN

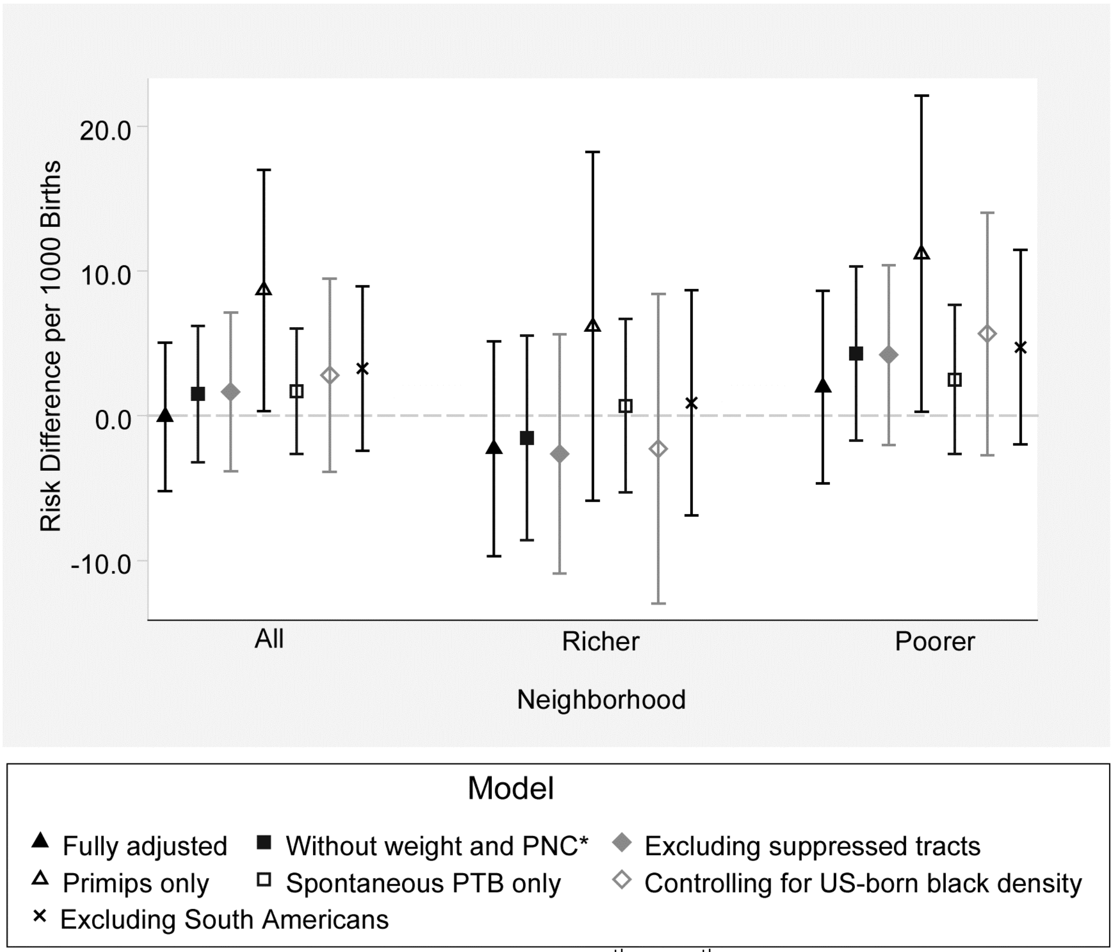


* Risk differences correspond to a change from 10th to 90th percentiles of ethnic/immigrant density. Adjusted and stratified risk differences were calculated for women aged 20-34 who were high school-educated, had 2-5 previous live births, were nonsmokers, were on Medicaid, and resided in a more stable neighborhood. Adjusted risk differences were calculated for poorer neighborhoods.

APPENDIX 6C, continued

GRAPHICAL DISPLAY OF AIM 3 SUPPLEMENTAL RESULTS

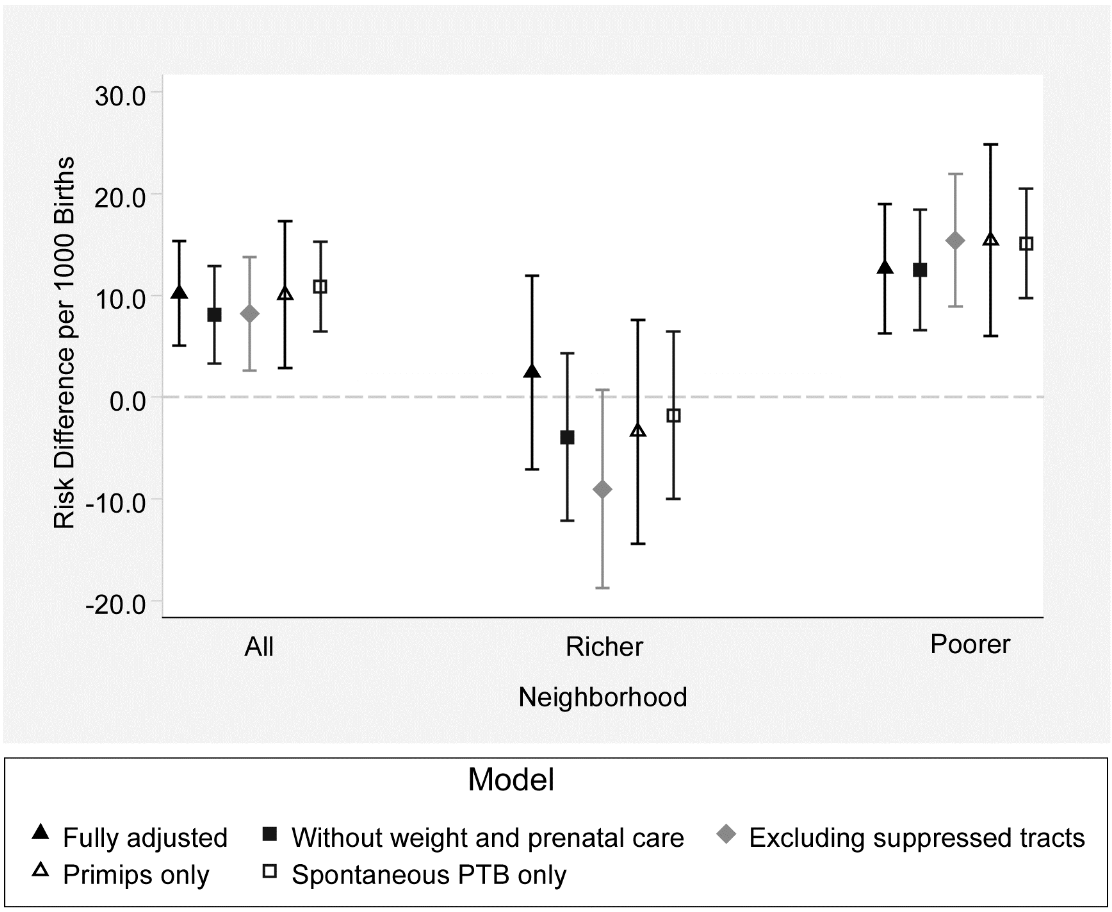
CARIBBEAN-BORN NON-HISPANIC BLACK WOMEN



* Risk differences correspond to a change from 10th to 90th percentiles of ethnic/immigrant density. Adjusted and stratified risk differences were calculated for women aged 20-34 who were high school-educated, had 2-5 previous live births, were nonsmokers, were on Medicaid, and resided in a more stable neighborhood. Adjusted risk differences were calculated for poorer neighborhoods.

GRAPHICAL DISPLAY OF AIM 3 SUPPLEMENTAL RESULTS

US-BORN NON-HISPANIC BLACK WOMEN



*Risk differences correspond to a change from 10^{th} to 90^{th} percentiles of ethnic/immigrant density. Adjusted and stratified risk differences were calculated for women aged 20-34 who were high school-educated, had 2-5 previous live births, were nonsmokers, were on Medicaid, and resided in a more stable neighborhood. Adjusted risk differences were calculated for poorer neighborhoods.

APPENDIX 6D

AIM 3 RISK DIFFERENCES FOR SELECTED AFRICAN AND CARIBBEAN SUB-GROUPS

ETHNIC/IMMIGRANT GROUP & COUNTRY SUB-GROUPS	MODEL					
	Adjusted		Stratified: Richer neighborhood		Stratified: Poorer neighborhood	
	RD	(95% CI)	RD	(95% CI)	RD	(95% CI)
African-born						
Nigerian	-2.4	(-11.7, 7.0)	-7.7	(-20.3, 4.8)	0.0	(-10.6, 10.6)
Ghanaian	5.0	(-3.6, 13.6)	-0.9	(-6.8, 5.0)	15.7	(4.5, 26.8)
Caribbean-born						
Jamaican	3.2	(-5.9, 12.2)	0.9	(-13.0, 14.7)	5.0	(-0.5, 16.6)
Haitian	0.7	(-11.8 13.1)	-0.7	(-17.2, 15.8)	1.7	(-16.0, 19.4)

*Risk differences correspond to a change from 10^{th} to 90^{th} percentiles of ethnic density. Adjusted and stratified risk differences were calculated for women aged 20-34 who were high school-educated, had 2-5 previous live births, were nonsmokers, were on Medicaid, and resided in a more stable neighborhood. Adjusted risk differences were calculated for poorer neighborhoods.

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