THE EFFECTS OF INSTITUTIONAL RACISM, PERCEIVED DISCRIMINATION AND MATERNAL STRESS ON PRETERM BIRTH

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ABSTRACT

DARA D. MENDEZ: The Effects of Institutional Racism, Perceived Discrimination and Maternal Stress on Preterm Birth
(Under the direction of Dr. Vijaya K. Hogan)

There are tremendous racial/ethnic disparities in preterm birth that have not been ameliorated. Individual health risks do not explain these disparities, and there is limited research exploring the social and contextual factors contributing to these disparities. This research explores institutional racism as a fundamental cause of the racial/ethnic disparities in preterm birth.

The Home Mortgage Disclosure Act (HMDA) database was used to create a measure for residential redlining and the 2000 US Census was used to create measures for residential redlining and percentage black. The Stress Pregnancy Evaluation Community Project (SPEAC), a cohort of pregnant women (N=3949), had linked vital birth records and geocoded addresses, which were linked to measures of redlining, segregation and percent black on the census tract level. Multilevel logistic and linear regression models were used to examine the relationship between institutional racism and preterm birth (and change in gestational age) using SAS 9.2.

The first dissertation paper examined the distribution of residential redlining in the neighborhoods where the SPEAC cohort lived. We also examined the racial/ethnic differences in residences in redlined neighborhoods. We found that the majority of the

SPEAC population lived in redlined neighborhoods and that non-Hispanic black women were more likely to live in redlined neighborhoods.

The second dissertation paper examined the relationship between residential redlining and perceptions of discrimination, stress and neighborhood quality. We also examined racial/ethnic differences in these same perception measures. Black non-Hispanic women had a greater mean residential redlining index, greater perceived everyday discrimination score, and more adverse ratings of neighborhood quality compared to women of all other racial/ethnic groups. Residential redlining was positively associated with perceived poor neighborhood quality but was not associated with perceived discrimination or stress for the overall SPEAC population. However, residential redlining was associated with perceived discrimination among non-Hispanic white women only. Residential redlining was moderately associated with percent black on the census tract level and residential segregation.

The final dissertation paper examined the relationship between residential redlining and the risk of preterm birth (and change in gestational age). We also examined racial/ethnic differences in preterm birth and whether residential redlining contributed to the black-white disparity in preterm birth. Residential redlining and perceptions of stress, discrimination and neighborhood quality were not significantly associated with preterm birth. Additionally, residential redlining did not contribute to the black-white disparity in preterm birth.

This dissertation is dedicated to the women and infants who made this research possible. May this research not be in vain but an avenue for understanding injustice and inequities in health.

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LIST OF ABBREVIATIONS

CI	Confidence Interval
GA	Gestational Age
GIS	Geographic Information System
HMDA	Home Mortgage Disclosure Act
M	Mean
ML	Multilevel Modeling
NH	Non-Hispanic
OR	Odds Ratio
PTB	Preterm Birth
SPEAC	Stress Pregnancy and Evaluation Community Project
VPTB	Very Preterm Birth

CHAPTER 1: INTRODUCTION

Statement of the Problem

Preterm delivery is a major public health concern that contributes substantially to excess neonatal and infant mortality (1). In the US, black infants are more than twice as likely to die within the first year of life compared to white infants and preterm birth is the major contributor to the black infant death rate (2, 3). Additionally, the racial/ethnic disparities in birth outcomes in the US have not improved substantially over the past few decades (2). There are many social, historical and biological factors that influence preterm birth. Additionally, many factors contribute to the black-white disparity in preterm birth, yet these factors are not fully understood. Researchers investigating disparities in perinatal health have explored the social context as fundamental causes of the disparity (4-7). The social context of health entails understanding the life experiences through social status markers such as person's race, class and gender (5, 8-10). For example, the social experience of blacks in the US has been associated with experiences of racism and discrimination, which can affect an individual's exposure to chronic stress as well as disproportionate access to resources and services.

Racism is a social stressor that could potentially influence group differences in health outcomes such as preterm birth (9). Racism can come in the form of day to day experiences, institutional racism and internalized racism. Everyday experiences of personally-mediated racism as a life stressor have been studied in relation to a variety of health outcomes, including but not limited to preterm birth, low birth weight and cardiovascular disease. The

focus of this research study is exploring the relationship between institutional racism and birth. Institutional racism refers to the major policies, norms and institutions that result in differential access to resources and power based on race (11). Institutional forms of racism have not been adequately studied in relation to health and well-being and have implications for understanding social and contextual factors that contribute to the disproportionate burden of excess mortality and morbidity for Black infants and infants of other minority populations. Evaluating racism as a contributor to adverse birth outcomes is important for understanding the social context of health and birth and uncovering factors contributing to the disparity.

This study will apply two objective measures of institutionalized racism: 1) housing discrimination based on race (residential redlining) and; 2) residential racial segregation, and assess their effects on preterm birth. Redlining is a term used to describe the practice of biased mortgage appropriations in minority communities and will be measured using the Home Mortgage Disclosure Act Database (HMDA). The HDMA includes information on property values, loan dealings and sociodemographic information of communities throughout the US (12). An index of racial residential segregation will also be developed from community-level racial composition data from the 2000 US Census.

The overall goal of this research study is to measure the associations between residential redlining, segregation, perceived discrimination, perceived stress, perceived neighborhood quality and preterm birth. Quantitative measures of institutional racism were measured in an inner-city, urban population of pregnant women from the Stress, Pregnancy and Evaluation Community Project (SPEAC), a study designed to investigate the relationship between social stressors and bacterial vaginosis. Measures of individual-level perceived discrimination were operationalized as everyday and major experiences of discrimination,

will be included in the analysis. While perceived discrimination and racism have been measured at the individual level in many health studies, institutional racism at the community level has not been adequately explored in relation to health outcomes. To date, there are no studies which have used redlining as a measure for institutional racism among a population of pregnant women to assess an association with birth outcomes. Consideration of contextual factors such as residential segregation and redlining may be important for future research, intervention and policy related to eliminating health disparities and for identifying a primary social condition as the cause of the disparity (12). This research will develop an index of residential redlining from the HMDA database. Additionally, measures of redlining and residential segregation have not been previously studied simultaneously with chronic stressors in association with birth outcomes.

Research Questions and Hypotheses

Specific Aims

The specific aims of this research study are to:

Aim 1. Examine the extent to which residential redlining and segregation exists in the neighborhoods where the Stress Pregnancy and Evaluation Community Project (SPEAC) cohort reside. To accomplish this aim, we will develop a residential redlining index using multilevel logistic modeling for future applications in public health research. We will then examine whether residential redlining is associated with residential segregation and percent black on the census tract level. Finally, we will map the levels of redlining in the neighborhoods in Philadelphia County in which the women in the SPEAC cohort live.

Research Question 1A: What are the levels of residential redlining and segregation in the neighborhoods in Philadelphia County in which the SPEAC cohort live and are there differences by race/ethnicity?

Hypothesis 1A: There will be racial/ethnic variation within the SPEAC for residence in neighborhoods by levels of residential redlining and segregation. We hypothesize that Black will be more likely to live in redlined and segregated areas compared to white women.

Research Question 1B: Is residential redlining associated with residential segregation and percentage black on the census tract level?

Hypothesis 1B: Residential redlining will be positively associated with residential redlining and percent black.

Aim 2. Examine the relationships between residential redlining and segregation, perceived discrimination, perceived stress and perceived neighborhood quality for the entire SPEAC cohort and for each racial/ethnic group.

Research Question 2A: Which racial/ethnic group is more likely to experience living in neighborhoods that are redlined and segregated and report experiences of discrimination, stress and poor neighborhood quality?

Hypothesis 2A: We hypothesize that black women are more likely to live in neighborhoods that are redlined and segregated and report discrimination, stress and poor neighborhood quality compared to white women.

Research Question 2B: Is residential redlining associated with perceived discrimination, stress and neighborhood quality?

Hypothesis 2B: Women who live in redlined neighborhoods will be more likely to report experiences of discrimination, stress and poor neighborhood quality compared to women who do not live in redlined neighborhoods.

Research Question 2C: Is there an association between perceived discrimination and perceived stress?

Hypothesis 2C: Women who perceive discrimination will be more likely to perceive stress compared to women who do not perceive discrimination.

Research Question 2D: Is there an association between perceived neighborhood quality and perceived stress?

Hypothesis 2D: Women who perceive poor neighborhood quality will be more likely to perceive stress compared to women who do not perceive poor neighborhood quality.

Aim 3. Determine if there is an independent association between institutional racism (in the form of neighborhood redlining and racial residential segregation) and preterm birth (and gestational age). To achieve this aim, we will examine the perceptions of discrimination, stress and neighborhood quality in association with preterm birth (and gestational age), and we will examine whether residential redlining contributes to the racial/ethnic disparity in preterm birth.

Research Question 3A: Is there an independent association between institutional racism (in the form of residential redlining and segregation) and preterm birth (and gestational age)?

Hypothesis 3A: Women who experience high levels of institutional racism (in the form of residential redlining and segregation) will have a greater risk of preterm birth

compared to women who do not experience institutional racism after controlling for important covariates. Women who experience institutional racism will give birth at lower gestational ages.

Research Question 3B: Is there an independent association between perceived discrimination and preterm birth?

Hypothesis 3B: Women who perceive discrimination will have a greater risk for preterm birth. Women who perceive discrimination will give birth at lower gestational ages.

Research Question 3C: Is there an independent association between perceived neighborhood quality and preterm birth?

Hypothesis 3C: Women who perceive poor neighborhood quality will have a greater risk for preterm birth compared to women who do not perceived poor neighborhood quality. Women who perceived poor neighborhood quality will give birth at lower gestational ages.

Research Question 3D: Is there an independent association between perceived stress and preterm birth?

Hypothesis 3D: Women who perceive stress will have a greater risk for preterm birth compared to women who do not perceive stress. Women who perceive stress will give birth at lower gestational ages.

Research Question 3E: Does residential redlining explain the black-white disparity in preterm birth?

Hypothesis 3E: The odds ratio of preterm birth comparing black non-Hispanic to white non-Hispanic women will be reduced when taking into account residential redlining even after controlling for important covariates.

CHAPTER 2: REVIEW OF RELEVANT LITERATURE

The Extent of the Problem: Racial and Ethnic Disparities in Birth Outcomes

There are persistent racial disparities in perinatal health outcomes such as infant mortality, preterm birth (PTB), and low birth weight (LBW). The infant mortality rate, defined as an infant death with the first year of life, is used as an indicator for the progress of the overall health status and access to healthcare of a nation (13). While there has been a reduction in the overall infant mortality rate in the United States over the past few decades, the disparity between blacks and whites remains unchanged (2). The disparity in infant death rates between blacks and whites has actually doubled since 1950 (14). The infant mortality rate declined by 42.5 percent for all races between 1980 and 2000 (from 12.6 to 6.9 deaths per 1,000 live births) while the decline for whites was 47.7 percent (from 10.9 to 5.7) and 36.9 percent (from 22.2 to 14.0) for blacks resulting in an increase in the black-white rate ratio of infant mortality from 2.0 to 2.5 between 1980 and 2000 (2). This disparity remained after the year 2000, as the infant mortality rate for blacks increased from 13.3 in 2001 to 13.8 in 2002 and from 5.7 to 5.8 respectively for whites (15). A significant proportion of this infant mortality disparity is attributed to the higher rates of preterm birth, low birth weight, and very low birth weight among black infants (1).

Preterm birth, the primary outcome in this study, is one of the leading causes of infant deaths. It is measured as more than 20 weeks and less than 37 weeks gestation. In the US, about 12.5 percent of births are preterm, and the rate of preterm birth has increased by 30 percent since 1981 (16). According to the Centers for Disease Control and Prevention

(CDC), the four leading causes of infant mortality in the United States include congenital malformations, preterm birth and low birth weight, sudden infant death syndrome (SIDS), and maternal complications. The leading causes for white women follow this same pattern (15). However, the four leading causes of infant mortality for black women are slightly different, with preterm birth being a primary contributor, followed by low birth weight, congenital malformations, SIDS, and maternal pregnancy complications (15). Black women also have higher preterm birth rates compared to white women (2, 3, 15, 17, 18). Preterm birth has a very complex etiology that is not completely understand and health and social research has attempted to understand the numerous factors that contribute to excess preterm birth.

Major Risk Factors Associated with Birth Outcomes

Various researchers have investigated possible contributors to the racial and ethnic disparities in perinatal outcomes. Some of these factors include sociodemographic inequities (e.g. income and education), physical environmental factors, historical factors and psychosocial stress (7). There is an ongoing debate concerning the contribution of each of these to health disparities, yet it is arguable that these perinatal outcomes result from a complex interplay of biological, behavioral, psychological, and social factors that cannot be fully explained by one single cause (19, 20). For example, traditional risk factors used in research, such as individual income and health care usage, do not account for the excess rates of preterm birth among blacks (1, 19). When comparing foreign-born and U.S.-born women of African descent, foreign born women were less likely to give birth to a low birth weight infant or a premature infant than those born in the U.S., even after controlling for visits to a prenatal care facility, illegal drug use and demographic factors (21, 22). Earlier research

studies have found that higher levels of education and access to prenatal care did not provide equal levels of protection from the risk of having a VLBW birth, preterm birth, or infant death for African American women as it did for white women, and the gap was wider between African American women and white women as educational levels increased than women with less education from these two racial groups (23-28). Additionally, protective factors such as income and access to health insurance have not been shown to eliminate the racial gap in health (29). This demonstrates that perinatal health is complex and our understanding of what contributed to disparate rates is limited. Understanding the unique social, historical and economic experiences of black women in the US is essential to uncovering the root causes of racial/ethnic disparities (7, 17, 30).

Social and Neighborhood Contexts Influencing Birth Outcomes

The social environment as a fundamental determinant of health includes many factors such as physical surroundings, neighborhoods, social relationships, economic processes, community resources and power relations of women (31). Little is known about how these factors interact to produce adverse health outcomes (7). However, social determinants of health are essential in understanding the unique influences on black women's perinatal outcomes. There are some theoretical models, some backed by empirical research, that posit that neighborhood and community contexts influence a variety of health outcomes and determine levels of stress (32-35). An important aspect of considering neighborhood context is that it includes a woman's environment before, during, and after childbirth. Investigating neighborhood effects through multi-level analysis allows for both individual and contextual factors that influence health outcomes to be studied (35). Adverse health outcomes among

African Americans may be mediated by several environmental factors and experiences that shape behavior, influence social and health services, and affect physiologic functions (36, 37).

Social and contextual factors have a tremendous influence on health outcomes. Neighborhoods, communities or societies as a whole that experience high rates of crime, exposure to environmental toxins, lack of health resources, limited amounts of fresh produce and healthy foods, inadequate and safe housing, income inequalities, neighborhood deprivation and joblessness have been found to adversely affect health outcomes and health behaviors (35, 37-43). One study in Chicago using neighborhood-level income based on census tract residence and percent of families below poverty level, suggests that residential environment is a risk factor that should be considered in relation to race and perinatal outcomes(44). The intense concentration of poverty and residence in low-income urban areas was found to be a strong proxy for low birth weight among African Americans. A study of homelessness among adult childbearing women in Philadelphia found that African American women accounted for more than 90 percent of the homeless episodes between 1990 and 1998, and this has a huge influence on the overall health of populations(45). Other studies, which measured psychosocial stress levels and perceptions of neighborhoods found that pregnant women who rated their neighborhood poorly (i.e. unsafe, lack of resources) had an increased risk of preterm birth and low birth weight (46, 47).

An investigation of neighborhood social factors and their relationship to stress can help bring forth a better understanding of the relationship between external social factors such as neighborhood characteristics and levels of stress for certain populations. Knowledge about particular neighborhood factors' influence on health and explanations of these social

interactions with stress is limited. Further investigation is needed to understand the particular types of neighborhood factors, which may cause the most stress, with the goal of trying to intervene and possibly build upon neighborhood strengths. Additionally, psychosocial stress as a direct result of the social environment could potentially contribute substantially to the racial and ethnic disparities in birth outcomes.

Psychosocial Stress and Birth Outcomes

Stress is a term used to describe any physical or psychological challenge that threatens or is perceived to have the potential to threaten internal stability or homeostasis (48). Differences may exist in a person's capacity to withstand stress, cope with stressful situations, and react to stressful stimuli (19). Stress is a multidimensional construct that involves person-environment interactions and the conflicts between environmental demands and the individual's biological, psychological or social resources (48). Chronic stress can result in dysregulation of internal systems. Also known as allostasis, the biological systems work to maintain stability or homeostasis through this change and conflict (49). As a result of this conflict, the body goes through a process of "wear" and "tear" from the repeated cycles of allostasis generating a build-up of effect known as "allostatic load." The allostatic load influences several aspects of the individual's physiology including the regulation of biological functions, and disruption of these same functions, and disruption of the mediators that may influence this regulation process. Allostatic load can ultimately have long term affects (49). The physiologic load created by chronic exposure to stress accumulates over time, leading to an enhanced inflammatory response, and contributing to the poorer health outcomes that may be associated with particular populations (49-51).

Some literature shows that chronic stress has been associated with several adverse perinatal outcomes such as low birth weight and preterm birth, yet this association has not been firmly established (47, 48, 50, 52-56). The "weathering" hypothesis suggests that accelerated aging among African American women reflects the compounding effects of social inequality, racial discrimination, and exposure to psychosocial or environmental hazards over the lifespan leading to growing gaps in maternal and fetal health. As a result, the health status of African American women begins to deteriorate at an accelerated rate as a result of this prolonged insult on the body as well as coping with stressful experiences over long periods of time (57). One theoretical model poses a "biobehavioural perspective" where the effects of maternal stress on preterm birth may be mediated through specific biological and/or behavioral mechanisms (48). The two physiological pathways involved include the endocrine system or the immune-inflammatory pathway, where in both cases parturition is promoted. Since both of these pathways regulate one another, this theory poses that a multiplicative effect occurs creating an increased risk of preterm birth (48). Chronic stress could also arise from environmental and social factors that influence individual health and their behaviors. Stress can be influenced by social factors and therefore must be put in their proper context to truly understand the full range of factors that are at play in creating increased risk (58).

Experiences of Racism as a Social Stressor

Experiences of racism are a unique and distinct set of stressors experienced by particular populations of women in the US and may result in adverse health outcomes for pregnant women. Racism can be defined as beliefs, attitudes, institutional arrangements and policies at three different levels: institutional, personally-mediated and internalized (9, 11).

Experiences of racism can be described as not just one specific incident but a part of historically created "racial constructions" and "structural realities" that influence various facets of life (59). Institutional racism refers to policies, norms or institutions that maintain structures of power in society. Personally-mediated racism refers to preferential treatment in day-to-day experiences such as being followed in a store because of your race. Internalized racism refers to believing the negative stereotypes about one's own racial group. Racism operates as a psychological stressor embedded in the multiple contexts shaping the lives of African American women of childbearing age and their health and birth outomes (60).

Stressful life experiences, such as individual reports of personally-mediated racism, and its association with health and birth outcomes have been investigated in several research studies including national studies. (44, 56, 61-63). One of the first studies about experiences of racial discrimination and infant birth weight was conducted by Collins and colleagues (44). The study found that the odds of very low birth weight (VLBW) for maternal exposure to racial discrimination were 3.2 (95% C.I. 0.9, 11.3) after adjusting for age, parity, prenatal care, social support, alcohol use, and drug use compared to women of normal weight (44). Additionally, reports of racial discrimination vary by income or socioeconomic position. Another study by Rosenberg and colleagues found a stronger association of some of the measures of personally-mediated racism with preterm birth among women with no more than 12 years of education where unfair treatment on the job was associated with preterm birth among women with 16 or more year of education among a cohort of primarily college of educated women (61). Several other studies measuring individual levels of racial discrimination and birth outcomes have similar findings (56, 62, 63). Perceived discrimination has also been associated with other health outcomes such as depressive

symptomology and hypertension (64). Understanding a person's understanding or appraisal of experiences of discrimination is important. However, the focus on the individual-level experience leads to individual-level solutions. There are also potential biases in self-reports of experiences of racism if a person does not appraise this type of social stressor. Institutional racism, measured on a neighborhood or community level, could capture a woman's experience that may not be perceived or reported in survey data.

Institutional Racism: "Redlining" and Residential Segregation

Institutional racism could influence health in the absence or presence of individual recognition of discrimination (11). Institutional racism refers to the policies, norms and institutions that sustain racial divisions and inequality (11, 65). This can be the product of both overt and covert actions, resulting in a separation of racial groups, disinvestment in racially mixed or non-white communities, and directing investment and resources into homogenous, all-white communities (65). Forms of structural or institutional racism include Jim Crow laws and residential segregation that have influenced health services, housing, education, employment, and attainment of wealth in the United States. One example includes institutional racism in housing policies and practices such "redlining," which resulted in black-white differences in wealth where housing equity is a major sources of wealth (38). The racial differences in wealth and opportunities may be a result of past policies, but are maintained via contemporary policies, practices and norms.

Redlining, or mortgage lending discrimination, is the practice of banks and other financial institutions denying loans to communities based on race. The term "redlining" was coined by community groups in Chicago in the late 1960's to describe the practice of

drawing red lines around areas where lenders refused to provide loans or provided loans with less favorable terms (66). Although the term was not coined until the 1960's, the practice existed decades before then. Lenders depended on this insurance provided by the FHA during the time due to the high rate of foreclosures after the Great Depression (65). Additionally, the 1934 Housing Act was set to bolster home ownership and improvement, provide credit and increase employment, yet many blacks were denied the benefits of this act (65). Around the same time, there was the "Great Migration" of about 2 million of African American who left to South to move to urban regions in the North. For example, Philadelphia's black population grew from 84,500 to 220,600 between 1915 and 1930 (65). Competition for housing and resources resulting in racial conflicts, cross-burnings and violent race riots (65). This set off a series of US city policies and actions including zoning and deed restrictions to impose and increase residential segregation.

Several decades later, the Fair Housing Act of 1968 was enacted to "prohibit discrimination at any stage of the lending or home insurance process" (66). To counteract and regulate the current and historic discriminatory practices, The Home Mortgage Disclosure Act (HMDA) of 1975 also was instituted to enhance enforcement laws prohibiting discriminatory lending and "redlining". Lenders report information about the types of loans that they give to their consumers, which is included in the HMDA database. In 1989, Congress expanded HMDA data to include information about loan denial as well as the sex, race and income of the applicant. The HMDA is a mechanism for measuring housing discrimination through "redlining," a practice where lending institutions are biased in regards to loan appropriations to minority groups (12, 67, 68). Lenders are usually not required to report HMDA data unless they are located in a metropolitan statistical area (MSA) and hold a

minimum level of assets (67, 69). The practice of "redlining" exists today in the form of denial of loans and "reverse redlining" through subprime lending (70). Home buyers in minority neighborhoods are more likely to receive subprime loans compared to white communities in recent years although median income levels were comparable and credit histories were similar (70). Additionally, blacks tend to receive smaller returns on an investment in a home than whites do (38). The SPEAC study, based in an urban area, is an appropriate database to connect with the HMDA. The Federal Financial Institutions Examination Council (FFIEC) releases the HMDA files yearly. Lenders include banks, savings and loans associations, credit unions and mortgage and consumer finance companies. Housing discrimination and "redlining" are likely causes of residential segregation resulting in major differences in neighborhood environments (71). Additionally, redlining may result in one very unique exposure for black women that could determine excess rates on adverse birth outcomes and other health outcomes.

Residential segregation has been suggested as the "cornerstone" on which racial and ethnic disparities have been built (38). Residential segregation refers to the geographic separation of two groups (38, 72). Residential segregation has been noted to exist as a result of "redlining" and because of racial restrictions on government-insured housing (65). Legislation such as those instituted by the FHA was supported by the federal government and major economic institutions and was legitimized by the ideology of white supremacy (38). Nationally, the index of dissimilarity, one of the indices to measure segregation, declined from 0.70 in 1990 to 0.66 in 2000 indicated that 66 percent of blacks in the US would have to move to have an even distribution (73). However, the decline in segregation was the result in

the reduction of all-white census tracts with very little impact on high percentage of black tracts, the residential isolation of blacks, or concentrated urban poverty (73).

Massey and Denton hypothesized that residential segregation acts to concentrate poverty among neighborhoods of color (74). Poor blacks are more likely to be concentrated in high-poverty neighborhoods while most poor white people are residentially located near non-poor people (32, 38). Understanding residential segregation and location is important because it influences proximity to important resources, including institutions such as schools, hospitals, child care facilities and labor markets (75). Residential segregation is also linked to employment restrictions, socioeconomic conditions on an individual and neighborhood level, the wealth gap as a result of home equity differentials, and differences in neighborhood quality (38). Previous research studies have found pertinent relationships between health outcomes and neighborhood level data such as residential segregation. Understanding how specific neighborhood and community contextual factors interact to affect behavior, access, and biological systems is essential in order to implement change. Several studies investigate the relationships between residential segregation and health outcomes but only one to date utilizes the institutional measure, "redlining," in relation to health outcomes with a focus on general health status and mental health among Chinese Americans in California (12).

Institutional Racism and Health

Institutional racism in the form of housing discrimination (as measured by redlining and residential segregation) could potentially influence the health of populations. Institutional and structural factors are quite difficult to capture and measure in epidemiologic studies. Measures such as "redlining" have not been operationalized or evaluated in the

context of birth outcomes among a US population. As a result, previous studies have also been limited in generating conclusions about structural factors as possible contributors to the racial and ethnic gap in birth outcomes such a preterm birth and low birth weight.

Measurements of institutional forms of racism such residential segregation and "redlining" are also important in understanding social and contextual factors related to health beyond an individual's ability to self-report everyday experiences of racism. Discrimination leads to segregation and in turn produces economic disparities by inciting restrictions in economic opportunities for blacks, producing further discrimination and more segregation (68). Several studies employ the index of dissimilarity, a scale commonly used by researchers to measure residential evenness by racial or ethnic composition. The index of dissimilarity is a standard segregation index which is the relative number of black people who would have to change geographic locations so that an even black-white spatial distribution could be achieved (68). A study on infant post-neonatal mortality and racial residential segregation found an increased risk of black neonatal mortality was associated with higher levels of segregation, poverty and lower levels of relative black political power (76). Another study found that blacks living in hypersegregated areas had significantly higher rates of preterm birth compared to blacks living in non-hypersegregated areas and that hypersegregation contributed to the black-white disparities in preterm birth (77). There is a possibility that there is an interaction between the effects of redlining, residential segregation and percentage of blacks in a neighborhood. Residential segregation influences the depletion or accumulation of resources within a community which influences employment, education, location of environmental toxins, alcohol and tobacco advertising, housing quality, food availability and health behaviors, which in turn influence health outcomes (38, 78). Racial

residential segregation as a form of institutional racism is important in understanding the web of causation responsible for inequities in health (38).

A challenge to using institutional racism in epidemiologic research is its operationalization. Only one study to date incorporates the use of the HMDA to measure redlining among a population of Chinese-Americans to investigate health outcomes (12). The study examined whether individual (self-perceived) and institutional (segregation and redlining) racism was associated with health status using the Chinese American Psychiatric Epidemiologic Study (CAPES), the 1990 US Census and the 1995 HMDA database. Residential segregation was also measured using the index of dissimilarity and redlined areas were operationalized as census tracts where Asian home mortgage loans were disfavored by 40 percent in comparison with white applicants. Respondents in redlined areas were 42 percent more likely to report discrimination than those living in other areas. Those living in redlined areas had better general health, better mental health and lower distress, which is contrary to the expected results. It is posited that Chinese Americans living in redlined areas may be generally healthier or take on more health promoting behaviors because the redlined areas in the study were more likely to be affluent and had more resources. Self-reported experiences of racism predicted lower levels of mental health and higher levels of psychological symptomatology (12). There were some favorable attributes and better general health outcomes associated with the redlined neighborhoods in California that Chinese Americans lived in. However, the case may be different for other ethnic minority population in the US. The measures and methods in this study have not been applied to any other populations and will be applied in the proposed study.

Limitations of Previous Research

Previous studies on the effect of racism on perinatal health have primarily focused on individual reports with few public health studies focusing on institutional racism. There are methodological issues in the previous studies that have potentially biased conclusions and have limited a deeper understanding of the relationship between racism and birth outcomes. Those methodological issues include misclassification of racial discrimination due to biases in self-report of personally-mediated racism and limited measurements of institutional forms of racism. Many studies measure racial discrimination through self-report of specific experiences that may have occurred in five domains (e.g. at school, work, in a restaurant). The ability for a respondent to recall a specific experience of racial discrimination may be minimal, particularly for populations that may experience "chronic" or continuous acts of discrimination and for racial or ethnic enclaves that may be generally isolated due to residential segregation. Interpersonal racism as a level or type of racism is important in understanding personal experiences, but it may not fully capture the social environment of marginalized and vulnerable groups of people. Some studies have measured institutional forms of racism within neighborhoods in the form of residential segregation in association with health. However, no other studies utilize other measures for institutional racism, such as redlining, on the community level in association with birth outcomes. As a result, this study will fill the gap in this research by measuring the effect of institutional racism on preterm birth to gain an understanding of contextual, social contributors in perinatal health.

Theoretical and Conceptual Model

The theoretical and analytic approach for this study is guided by the conceptual model in Figure 2.1. The conceptual model is a derivation of the Contextual Biopsychosocial

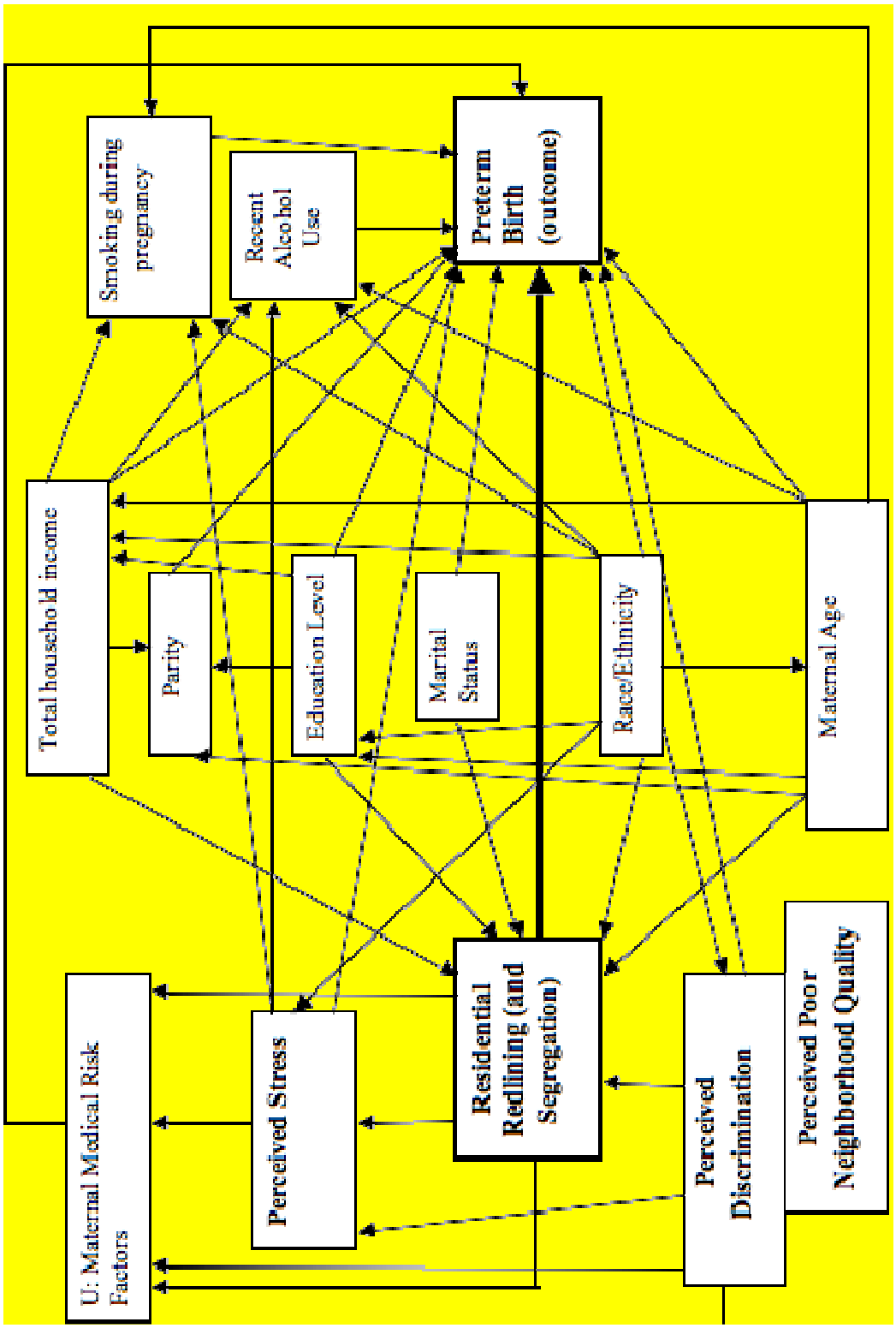
Model which builds upon a general stress-coping model developed by Lazarus and Folkman (9). This model also draws from ecosocial theory, which takes into account both micro and macro factors in relation health or well-being (79). The ecosocial framework coined by Krieger is useful for understanding the links between discrimination and health by studying potential pathways leading to the embodiment or "biological expression" of discrimination (63, 79). The model below illustrates the hypothesis that social stressors such as institutional racism and perceived discrimination directly and indirectly influence birth outcomes.

In the conceptual model, the major components are community environmental factors, institutional racism, reports of discrimination, perceptions of stress, sociodemographic factors, and birth outcomes. Institutional racism in the form of "redlining" and residential segregation are environmental stimuli or macro-level factors that could directly influence birth outcomes through a process of racialization. Racialization "refers to the ways in which people are sorted into racial categories, resources are distributed along racial lines, and state policy shapes and is shaped by the racial contours of society" (65). "Redlining" and historical and current policies instituted by government agencies such as the FHA are some examples of this. In this case, pregnant women who experience institutionalized forms of racism may be more likely to live in communities with less resources and more adverse conditions, resulting in adverse birth outcomes.

Institutional racism may also directly influence reports of discrimination or directly influence perceptions of life stressors. Women may or may not report the stressors they experience, which possibly influences the pregnant women's overall health and birth outcomes. Individual sociodemographic factors such as race, SES, class and gender are social status markers that influence exposure to institutional racism. These factors could

potentially moderate the association between institutional racism and reports of stressors (e.g. perceived discrimination). An association between reported discrimination and perceived stress, measured simultaneously, is also specified in the model. In this case, perceived discrimination is a distinct type of stressor and may be linked with overall reports of maternal stressors. The perceptions of stressors during pregnancy may be associated with birth outcomes. Other unmeasured environmental factors (e.g. employment rates) included in the model could be influenced by institutional racism and potentially influence self-reports of discrimination, perceived stress and birth outcomes directly. The conceptual model will guide analyses with a particular focus on specific aims two and three.

Figure 2.1: Directed Acyclic Graph of associations between residential redlining, segregation, perceived discrimination, stress, poor neighborhood quality and preterm birth



Significance

This research proposal will contribute to the public health field and is significant for several reasons. First, existing racial and ethnic health disparities in preterm birth have not improved significantly over the past fifty years. Understanding the social and contextual factors influencing these outcomes, above and beyond individual choices or behaviors will be important for future interventions and policies aimed to eliminate disparities. Second, this project will begin to conceptualize and utilize measures related to institutional racism that may be associated with health. Institutional racism in the form of housing discrimination as measured by "redlining" has not been applied to studies focused on birth outcomes (12). Additionally, the knowledge generated from this study can be applied to various contexts and settings throughout the United States to understand the complexities of health. Although "redlining" has been evaluated as a policy issue, these public policy issues can be applied in the public health context as a social determinant of health. In addition, the use of the HMDA database in public health research to understand contextual factors in relation to health will be an added benefit, potentially generating cross-disciplinary studies and future work. Agencies interested in achieving health equity will take into account how implementing mandates, policies and laws that may not fit within the strict confines of health policy can potentially influence health. Finally, applications of contextual level factors or even social policies such the HMDA have the potential to influence future public health policies and health outcomes.

CHAPTER 3: RESEARCH DESIGN AND METHODS

Study Overview

The proposed study will use data from the Stress Pregnancy and Evaluation Community Project (SPEAC), Pennsylvania vital birth records, the Home Mortgage Disclosure Act (HMDA) database and the US Census. This study will entail a secondary data analysis using the SPEAC dataset linked to vital birth records. The SPEAC dataset is also currently linked to some 2000 US Census measures that were used to create measures for residential segregation. The 2000 US Census data will be linked with the Home Mortgage Disclosure Act (HMDA) database to obtain a measure of neighborhood "redlining." This measure will be linked to each subject in SPEAC. The purpose of this study is to employ a measure of "redlining" as an objective, institutional measure of racism and apply it to an urban population to understand the relationships between reported personally-mediated racial discrimination, maternal stress and perinatal health. Such an objective measure of institutional racism has not been applied in perinatal health research.

Study Population and Datasets

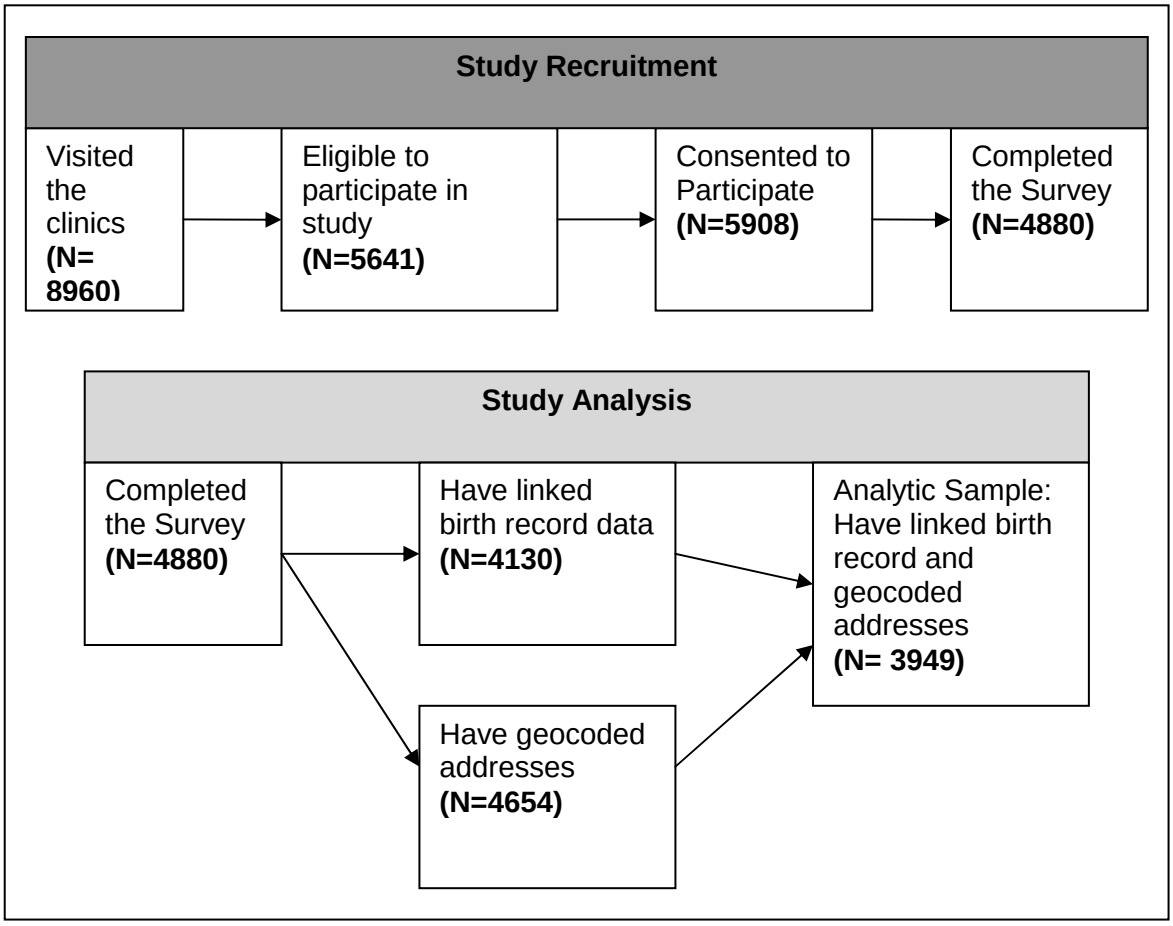
The study population comes from a cross-sectional study conducted in Philadelphia, PA (SPEAC) (25, 26). The SPEAC data includes a linked birth record for each woman who participated in the SPEAC study. The data were collected from 1999-2004 by the Department of Obstetrics and Gynecology at Jefferson Medical College, Thomas Jefferson University to investigate the relationship between chronic maternal stress and bacterial vaginosis (BV) for pregnant women enrolled at the time of their first prenatal clinic visit. A

total of 4880 pregnant women were in the final sample of women surveyed for the SPEAC study (See Figure 2: Flow Chart). The women received prenatal care from one of eight Philadelphia District Health Centers and two hospital-based clinics. Inclusion criteria for the SPEAC study were singleton gestation, intrauterine pregnancy, and English or Spanish speaking (25). All women regardless of foreign born status will be included in the initial analysis. The average gestational age at the time of BV screening and stress assessment was 14.8 weeks (26).

The SPEAC dataset includes information about personal experiences of discrimination, measures of stress (Cohen Perceived Stress Scale), individual neighborhood and housing characteristics and location of residence. Participants were also surveyed about their health history, health behaviors (e.g., smoking during pregnancy), pregnancy history (e.g., previous stillbirth), contraception usage, STI's, sexual behaviors, religious and spiritual practices, relationships, sleep patterns, job status, income and education. A total of 3950 pregnant women will be included in the final analysis because they had complete information for the birth record and their addresses were successfully geocoded (See Figure 3.1: Flow Chart).

The following flow chart (Figure 3.1) describes participants in the SPEAC study and those included in the final analysis for this study.

Figure 3.1: Flow Chart for Participation in the SPEAC Study



Birth record data for 1999-2005 were linked to the SPEAC survey. The SPEAC study data analysts used the mother's date of birth, address, and estimated date of delivery to match the SPEAC surveys with the birth files. Women who had miscarriages, still births or abortions would not have a birth certificate. As a result, survey information for 4130 (85%) SPEAC participants were successfully matched with the birth file. The women who completed the survey from 1999 through 2004 had births that took place from 1999 through 2005. The birth certificate includes the child's date and location of birth, demographic information for the mother and father, mother's pregnancy history, pregnancy length (gestational age), birth weight, medical risk factors of the mother, obstetric procedures, conditions of the newborn and method of delivery.

The HMDA is an administrative database created by the Federal Reserve Board (FRB) that collects yearly information from banks and other lending institutions providing mortgage loans. Each record in the HMDA Loan Application Register (LAR) represents an individual application for a residential mortgage loan or home improvement loan. For the purposes of this study, the analysis will focus on residential mortgage loans. The HMDA database includes information about the loan (i.e. type and amount of loan application), disposition (i.e. whether application was denied or resulted in an origination of the loan), property and location (e.g., single-family or multi-family units), applicant characteristics (e.g. race, sex) and whether the loan was sold (31). The HMDA will be used to create a variable for "redlining," which will be explained in further detail later.

The most up-to-date version of the HMDA database holds information about loan dealings from 1996-2006. The proposed study will use the records for the years 1999-2004 since the women in SPEAC participated during these same years. By 2003, the HMDA database began applying year 2000 Federal Information Processing System (FIPS) codes for census tracts and other census boundaries. Before the year 2003, FIPS codes for 1990 were used. As a result, census boundaries included in the HMDA database for years 1999 to 2002 used 1990 FIPS codes. This presents a problem because all census data included in HMDA from 2000-2010 should apply the 2000 FIPS codes. GIS specialist Amanda Henley, from UNC, was consulted to assist in remedying this issue. Henley performed a spatial join between centroids of the 2000 census blocks and the 1990 census tracts. The 2000 census blocks were downloaded and centroids were created using ArcGIS 9.2 ArcToolbox. The "inside" option was used to ensure that each of the centroids created was inside the original census block. A spatial join was done between the 2000 census block centroids and the 1990

census tract boundaries so that each 2000 census block was assigned to a 1990 census tract. This issue was addressed so that the women in SPEAC who were geocoded based on year 2000 FIPS codes could be matched with the 1990 FIPS codes used in the HMDA database. A total of 75 out of the 317 census tract boundaries for the women included in the SPEAC study changed slightly between 1990 and 2000. The following table includes the total number of records or individual loans applied for in a given year for the entire state of Pennsylvania and for Philadelphia County between 1999 and 2004, the study years for SPEAC.

Table 3.1. Home Mortgage Disclosure Act Records for Pennsylvania and Philadelphia County, 1999-2004

Year	PA State records (N)	All Philadelphia County and surrounding areas (MSAs) records (N)	Philadelphia County records Analytic Sample (N)
1999	872,027	104,326	15,672
2000	741,765	90,496	16,383
2001	1,021,412	95,849	14,006
2002	1,149,441	107,464	14,886
2003	1,526,632	143,637	17,709
2004	1,235,922	147,714	20,505
Average	1,091,200	114,914	16,527

*PA records (state code= 42)

These records were used to construct the Redlining Index for this study, which is described in further details below. The Philadelphia County records were of main interest although some other PA records outside of the county lines could be theoretically utilized and applied. In this case, if a woman received services and participated in the study but truly lived outside of the county lines, their census tract data would be picked up through the state data. Additionally, the analytic sample for the final analysis applies the exclusion criteria described earlier in further detail.

The US Census is an administrative database used to collect information about the population every ten years (decennially). The 2000 Census will be used for the proposed study, which includes a short and long form. The short form (100-percent characteristics) contains questions about sex, age, race and whether the home is owned or rented. The long form contains additional questions such as marital status, ancestry, disability, number of bedrooms in housing unit, available vehicles, income, work status, utilities, mortgage, taxes and fuel costs (36). The US Census was used to create variables for racial residential segregation, which will be explained below in further detail.

Measurements

Descriptions of Variables

The following three tables describe the dependent and independent variables and covariates included in the analysis for the proposed study (Tables 1-3). The individual level variables are acquired through the SPEAC survey and the community-level variables are acquired through the US Census and HMDA database.

Table 3.2: List of dependent measurements, definitions and sources

Variable	Definition	Source	Variable Level	Measurement in Original Dataset	Recoded Variables for Analysis
Gestational Age	Number of weeks gestation at time of birth	Linked Birth Record	Individual Level	Continuous *This form will also be included in final analyses	Continuous and Categorical 1= Preterm or Very Preterm Term 0= Term

Table 3.3: List of independent variables, measurements, definitions and sources

Variable	Definition	Source	Variable Level	Measurement in Original Dataset	Recoded Variables for Analysis
Report of Discrimination (Personally Mediated)	9 question scale of reported every day experiences of discrimination & 2 questions of reported major discrimination	SPEAC	Individual Level	-Continuous Summation (Everyday Discrimination) -Major Discrim: 0= No Events 1= One Event 2= Two Events	-Continuous (ED) -Categories (ED): 0=0 1=1-10 2-11-20 3=21+ (see explanation below) -MD: Same
Maternal Stress	Perceived stress measured by the Cohen Perceived Stress Scale (26,27)	SPEAC	Individual Level	Continuous	-Continuous -Categories: 0=0-0.5 1= >0.5-1.5 2= >1.5-2.5 3= >2.5-4 (see explanation below)
Reports of Neighborhood Quality	12 questions about how often the respondents see certain characteristics in their neighborhoods	SPEAC	Individual Level	Each Question: Scale of 1-10 (Rarely-Frequently) Questions are summed (D2sum) (See descriptions below)	-Continuous summation of scores -Categories (see explanation below)
Race/Ethnicity	Race/ethnicity of respondent	SPEAC	Individual Level	0=Non-Hispanic White 1=Latina/Hispanic 2='Non-Hispanic Black 3=Other	Will apply current measurement
Marital Status	Current marital status	SPEAC	Individual Level	1=Single 2=Married 3=Living As Married 4=Separated 5=Divorced 6=Widowed	0= Single 1= Married or Living as Married 2= Other (Separated, Divorced, Widowed)
Maternal Age	Age at time of survey completion	SPEAC	Individual Level	Continuous	Continuous

Variable	Definition	Source	Variable Level	Measurement in Original Dataset	Recoded Variables for Analysis
Parity	Number of previous births	SPEAC	Individual Level	Continuous	Categories: 0=None 1= One 2= Two or more
Maternal Education	Highest level of education attained	SPEAC	Individual Level	1=Grade school (Gr 1-6) 2=Some junior high (Gr 7-8) 3=Finished junior high (9th grade) 4=Some high school (Gr 10-11) 5= GED 6= High school graduate 7= Some college 8=College degree 9=Some graduate school 10= Graduate school degree	0=Post-HS 1=GED/HS 2=Less than HS
Yearly Income	Amount of money earned for the year	SPEAC	Individual Level	1=40,00+ 2=35,000-39,999 3=30,000-34,999 4=25,000-29,999 5=20,000-24,999 6=15,000-19,999 7=10,000-14,999 8=5,000-9,999 9= Under $5,000	Same
Tobacco Use	Tobacco use during pregnancy	SPEAC	Individual Level	0=No 1=Yes	Same
Alcohol Use	Alcohol use during pregnancy	SPEAC	Individual Level	0=No 1=Yes	Same
Time in current residence	How long the person has lived in the house or apartment	SPEAC	Individual Level	Continuous (# years and # months)	Same Categorized if appropriate

Variable	Definition	Source	Variable Level	Measurement in Original Dataset	Recoded Variables for Analysis
Percentage of race/ethnic groups within a neighborhood	Percentages will be based on the racial/ethnic composition of the neighborhoods (census tract)	US Census	Community Level	Continuous	Continuous (Percentage Black used in analyses)
Residential Segregation	Measured by index of dissimilarity or another segregation index	US Census	Community Level	Index of 0-1 (See derivation of index below)	Index of 0-1
Redlining Index (Current Housing Discrimination)	Discriminatory lending practices through loan disfavoring based on race. **This final measure will be derived by the HMDA variables described below.**	HMDA	Community Level (estimates for each census tract)	Initial beta estimates and OR's for all 311 census tracts (continuous)	-Same -Categories will also be chosen and included in some analyses (see description below)

Table 3.4: List of variables used to create the Redlining Index variable

Variable	Definition	Source	Variable Level	Measurement in Original Dataset	Recoded Variables for Analysis
Redlining (Current Housing Discrimination)	Discriminatory lending practices through loan disfavoring based on race. **This final measure will be derived by the HMDA variables described below.**	HMDA	Community Level (estimates for each census tract)	Initial beta estimates or OR's for all 300+ census tracts (continuous)	-Same -Categories will also be chosen and included in some analyses (see description below)
HMDA Variable: Loan Action Taken ("Outcome")	Whether the loan was denied or not. This variable will be used to create the final Redlining variable.	HMDA	(Community Level- loans are single loans for a specific census tract)	1=Loan Originated 2= Application approved but not accepted by applicant 3= Application denied by financial institution 4=Application withdrawn 5=File closed for incompleteness 6= Loan purchased by institution	1= Application Denied 0= All Others (Exclusions are described below)
HMDA Variable: Race of Applicant ("Main Predictor)	Race or national origin of the person applying for the loan. This variable will be used to create the final Redlining variable.	HMDA	Individual Loan (see above)	1= American Indian or Alaskan Native 2= Asian or Pacific Islander 3= Black 4= Hispanic 5= White 6= Other 7= Information not provided 8= Not applicable	Dummy Codes for races Example: Raceb:1= Blacks 0= All else Raceai: 1= Ameri. Indian 0=All else Etc. (referent group= white)

Variable	Definition	Source	Variable Level	Measurement in Original Dataset	Recoded Variables for Analysis
Sex of applicant	Sex of person applying for the loan. This variable will be used to create the final Redlining variable.	HMDA	Individual Loan (see above)	1= Male 2= Female 3= Information not provided 4= Not applicable	1=Male 0=Female (Others will be missing)
Gross Annual Income	Gross annual income of the person applying for the loan. This variable will be used to create the final Redlining variable.	HMDA	Individual Loan (see above)	Continuous	Continuous
Loan Amount	The total loan amount applied for. This variable will be used to create the final Redlining variable.	HMDA	Individual Loan (see above)	Continuous	Continuous

Outcomes

Preterm Birth and Gestational Age

The primary outcome of interest, preterm birth was primarily based on the clinical estimate of gestational age from the medical records and birth certificate for singleton infants born to the women who completed the survey. The gestational age estimation from the ultrasound was extracted from the women's medical records if the gestational age differed from the estimation from the birth records. If we could not find a reliable estimate from the birth record or medical record, the information was completed from phone calls to the participant. Preterm birth was defined as less than 37 weeks completed gestation, and very preterm birth was defined as less than 32 weeks gestation. The outcome will include both spontaneous and medically induced preterm birth.

In this analysis, the construction of this outcome will be investigated as a continuous gestational age variable as well as the traditional method of dichotomizing gestational age. Both the continuous measure and the dichotomous measures will provide information about differences in risk of preterm birth or low gestational ages as a function of institutional racism. The benefits of using the dichotomous preterm birth variables are that it allows for an evaluation of differences between two distinct groups. The categories chosen are not based on arbitrary cutpoints but have been used in health research and practice as indicators for infant development and survival. These distinct groups are based on relevant cut-points that also allow for easier interpretation. However, the dichotomous variable is more difficult to estimate in statistical programs (e.g. SAS) that apply multilevel logistic regression models. Dichotomizing this variable results in a loss of statistical power, loss of information about the overall distribution of gestational age, and could ultimately produce biased estimates (80, 81). On the other hand, the continuous gestational age can be easily estimated in statistical programs that apply multilevel linear regression models. The continuous gestational age allows us to see overall trends or perhaps a threshold in relation to the main exposure, "redlining. Additionally, maintaining the continuous gestational age variable does not result in a loss of power or information. However, the interpretation of this continuous measure is not as straightforward because one would determine an increase in one week of gestational age in relation to an increment change in the main exposure (redlining). Based on this information, both forms of the outcome of interest (i.e. categorized and continuous) are important and will be included in the analyses.

Individual Level Variables

Reports of perceived discrimination were measured by two assessments previously validated in similar populations. The assessments included the Everyday Discrimination Scale, which measures chronic and persistent experiences of discrimination (part 1) as well as modified version of major experiences of discrimination (part 2) (64, 82). In the first part, participants were asked, "I am now going to ask you some questions about discrimination that you may or may not experience in your day to day life. By discrimination, we mean being treated unfairly because of your race, ethnicity, income level, social class, sex, gender, age, sexual orientation, physical appearance, or religion. In your day to day life how often have any of the following things happened to you?" Nine scenarios were presented and scored on a six point Likert Scale.

Examples of the nine scenarios include the following:

Table 3.5: Everyday Experiences of Discrimination Questions, Part 1

"You are treated with less courtesy than other people"	Responses included: "almost everyday," "at least once a week," "a few times a month," "a few times a year," "less than once a year" and "never."
"You are treated with less respect than other people"	
"You receive poorer service than other people at restaurants and stores"	
"People act as if they're better than you are"	
"You are called names or insulted"	
"You are threatened or harassed"	

The respondents were asked another series of questions:

Table 3.6: Major Experiences of Discrimination Questions, Part 2

Question	**Responses**	**Reason based upon one of the following**
"For unfair reasons, do you think that you have ever not been hired for a job?"	"yes" or "no"	"ethnicity," "gender," "race," "age," "religion," "physical appearance," "sexual orientation," "income level/social class" and "other."
"Have you ever been unfairly stopped, searched, questioned, physically threatened or abused by the police?"		

A third question related to the original major experiences of discrimination assessment (part 2), addressing lack of promotion at work, was not included in the final survey (64). These questions were combined during the interview process to create the "summary discrimination score." This summed variable is divided into three categories: (1) "none or very little discrimination," (2) "some discrimination" or (3) "a lot of discrimination." The interviewer asks the respondent if this summed score captures their experiences. The respondent can reply with "yes" or "no." If the summary discrimination score did not capture the respondents' experiences, they were asked to describe their everyday experiences of discrimination. The options include: (1) "I experience no or very little discrimination," (2) "I experience some discrimination" or (3) "I experience a lot of discrimination." For the purposes of this study, the Everyday Discrimination scores were determined by summing across all nine questions and dividing by the number of questions actually answered by each respondent. We evaluated various categorizations for this sum score to determine its association with residential redlining. The final summed scores were categorized as follows: 0 (No discrimination), 1-10, 11-20, 21+.

Maternal stress is operationalized by the 14-item self-report Cohen Perceived Stress Scale (CPSS), a reliable and valid scale used in previous studies which measures the degree to which a respondent appraises stressful circumstances along dimensions of unpredictability, uncontrollability and overload (26, 27)(83). Examples of questions included in this scale are, "You have felt that you were unable to control the important things in your life," "You have felt nervous or 'stressed'" and "You have felt that you were on top of things." Participants can choose never, almost never, sometimes, fairly often or very often in response to the question. A total CPSS is computed by summing across all items. The scale is suggested

for examining the role of appraised stress in the etiology of disease (83). This variable as a continuous measure was explored to determine the best categorizations. Quartiles and the median split has been applied in previous studies among the SPEAC cohort as means to categorize this scale, but other options include maintaining the scale as a continuous measure and evaluating it in relation to preterm birth or gestational age for significant categorizations (54, 55). The median or mean split is not suggested for continuous measures due to loss of information and creation of biased estimates (80, 81). For this purposes of this analysis, the continuous summed scores were divided by the number of answered questions for each respondent. The higher scores indicate higher stress levels.

Perceptions of Neighborhood Quality. The SPEAC respondents answered specific questions about their neighborhoods. They were asked, "Please tell me how often these things are a problem or are found in your neighborhood:

Table 3.7: Perceptions of Neighborhood Quality Questions

Litter or trash on the sidewalks or streets	Responses included: Scale of 1-10 1 being rarely and 10 being frequently
Graffiti on buildings and walls	
Abandoned cars	
Vacant, abandoned, or boarded up buildings	
Drug dealer or users hanging around	
Drunks hanging around	
Unemployed adults hanging around	
Young adults hanging around	
Gang activity	
Houses and yards not kept up	
Racial slurs or attacks	
Gunshots	

A sum score was created by the research team for the 19 neighborhood quality factors. The distributions of the summation scores will be assessed to determine appropriate cutpoints. The study team that conducted the original survey divided the summation scores

into three categories to describe three levels of neighborhood quality: (1) Neighborhood is a good place to live, (2) neighborhood is an okay place to live, (3) neighborhood is not really a nice place to live. The values for each individual question, the summation scores and the categorized neighborhood quality variable were assessed to determine the most appropriate operationalization of the variable for the final analysis. For the purposes of this analysis, the continuous summation score was evaluated in addition to a categorized neighborhood quality variable which was the summation score divided by the number of answered questions by each respondent. The higher neighborhood quality scores indicate more adverse ratings of the neighborhoods or worse neighborhoods.

Other individual-level covariates are described in Table 3. Additional risk factors for preterm birth, which are available on the birth record but not included in table 3 are entry into prenatal care, use of tobacco, use of alcohol and existence of other medical risk factors. These additional risk factors will be explored as possible covariates in the final models. Finally, race and ethnicity are important variable. Some analyses (i.e. bivariate) will be stratified by race (e.g. blacks only), but race will not be included as a confounder in any final models.

Community Level Variables

General Census Level Variables. The percentage of racial/ethnic groups within a community (e.g. census tract) was also examined and derived from the 2000 US Census.

Redlining. This construct will be based on the Home Mortgage Disclosure Act (HMDA) database. Residential redlining is defined as differential or biased lending (e.g. mortgages) based on race or other personal characteristics rather than economic characteristics (34). It will be operationalized in this study as the rate of denial for home

mortgages when comparing blacks versus whites after controlling for income and other characteristics. The HMDA database includes individual loans for a given year for the entire country, including location information such as census tracts and states, with census tract being the smallest geographic unit. The redlining index will be created from HMDA by using the loan disposition (whether an application was denied or not). This study focuses on current housing discrimination, hence the final redlining index will exclude (1) incomplete applications that were not processed by lending institutions and therefore could not be part of a measure for loan disposition bias; (2) properties that are not owner-occupied (3) home improvement loans; and (4) multi-family unit which refers to purchasing, refinancing or home improvement loans (12). The final value from the redlining index as determined from HMDA will be assigned to each specific census tract. All records for Philadelphia, Pennsylvania were extracted from this database for the years 1999-2004 to match the years in which the women actually completed the SPEAC survey.

Analyses will be conducted to create a redlining index for each census tract. Multilevel logistic model with random effects will be used. This option will model racial difference in loan disposition for each census tract, the cluster of interest. The model will produce Beta estimates, which will be used in the final health models. These Beta estimates can also be used to create odds ratios for each census tract and can be used for the final health models as well. This may be the best option for constructing the redlining variable since it takes into account the individual loan information as well as the census tract information associated with the particular loan. The methods applied to these options will be explained in further in subsequent chapters.

Residential segregation. Residential segregation can be generally defined as the degree to which two or more groups live separately from one another (68, 74). The Perinatal Research Group for SPEAC merged three segregation measures with the SPEAC data by using the 2000 US census. They are the index of dissimilarity, exposure index, and isolation index. The *index of dissimilarity* ranges from 0 to 1 and measures the proportion of minorities (e.g. Blacks) that would have to change their area of residence to achieve an even distribution of the population in census tracts or block groups (28). The higher values indicate a greater degree of segregation. The index of dissimilarity is calculated as follows:

$$\mathbf{D}= \sum_{i=1}^{n} [\{t|p-P|\}/\{2TP(1-P)\}]$$

Where t and p represent the total population (t) and minority proportion (p) of area unit i (block); and T and P represent the total population (T) and minority proportion (P) of the larger area unit. This index measures the level of evenness or differential distribution of groups across areal units (84).

The *exposure index*, also known as the interaction index, ranges from 0 to 1 and measures the extent to which members of a minority group (e.g. blacks) are exposed to members of a majority group (e.g. whites) (84). The higher values indicate a greater degree of segregation. The exposure index is calculated as follows:

$$_{x}\mathbf{P}_{y} = \sum_{i=1}^{n} [x/X][y/t]$$

Where x, y and t are numbers of minority group members, members of the majority population and the total population in area unit i (block), respectively; and X represents the number of minority group members in the larger area unit (block group or tract) (84).

The *isolation index*, another measure of exposure, varies from 0 to 1 and describes the extent to which members of minority group X are only exposed to one another. The isolation index is calculated as follows:

$$_{x}\mathbf{P}_{\mathbf{x}} = \sum_{i=1}^{n} [x/X][x/t]$$

Where x and t are numbers of minority group members and the total population in area unit i (blocks), respectively; and X represents the number of minority group members in the larger area unit (block groups or tracts). Both the exposure index (i.e. the interaction index) and isolation index differs from measuring evenness (e.g. index of dissimilarity) in that it attempts to measure the experiences of segregation felt by the average minority or majority member (84). For example, a minority group may be evenly distributed throughout a city but may have limited exposure to a majority group if the minority group makes up a larger proportion of that city. This particular index takes into account the size of each group in determining the degree of segregation between them (84).

Both evenness and exposure are two equally important dimensions of residential segregation, but one will be chosen for the purposes of this research. The segregation measure is an important variable of interest although the redlining construct is the main exposure of interest. Segregation may be associated with redlining because it may be a result of persistent redlining in a community. Based on factor analyses of segregation dimensions, Massey found that evenness tended to be the most important dimension in explaining spatial variations in cities (84). As the result, this study will use the index of dissimilarity, which is a measure of evenness.

Unit of analysis for aggregate measures

An appropriate unit of analysis must be determined for aggregate neighborhood variables such as "redlining" and residential segregation. A consultant team from the University of Pennsylvania geocoded the addresses of the women who participated in SPEAC by using ArcView, resulting in a 95 percent match rate. Final X-Y coordinates were generated for the matched records and neighborhood identifiers based on the 2000 US Census (i.e. census tract) were attached to these records.

Possible neighborhood boundaries for this study include census tracts, census blocks, block groups and zip codes. The census block is the smallest geographic unit and usually contains between 300 and 3,000 people (36). Census tracks on average have 4,000 residents and are more economically, politically and culturally heterogeneous compared to census block groups (38). A prior study using SPEAC data geocoded participants' addresses to the census block group level to assign aggravated assault and homelessness rates to individual-level data (26). Previous research indicates that the block group and census tract levels have the largest statistical effect of economic disadvantage in relation to low birth weight and also maximize the precision and stability of area adverse birth outcome rates (35). Another study using SPEAC data compared traditional definitions of neighborhoods and other methods for measuring neighborhood context in association with preterm birth. They found that traditional census-based boundaries (e.g. census block) compared to alternative methods (i.e. raster and tapered densities within ½, ¼ and 1/8 mile radius) did not yield significantly different results in association with preterm birth (85). As a result, the census-based boundaries will be used for this study. Measures for racial residential segregation are at the block group level as the smallest unit of analysis. However, the census tract level will be

used as the final unit of analysis in creating the "redlining" variable since this is the smallest geographic unit in the HMDA dataset. There will be a total of 312 census tracts in the final analysis, and each census tract in SPEAC included between 1 and 77 respondents (average= 13).

Missing Data

From SPEAC/Linked Birth File

For this analytic sample, there are about 15 percent of the women in the SPEAC cohort without a linked birth file, resulting in missing data for the outcome of gestational age (i.e. preterm birth). Women without information for gestational due to the lack of a birth record will be excluded from the final analysis. However, other demographic characteristics and survey information for this population will be analyzed to see if they differ from the women with birth files. There are about 5 percent of the women who did not have geocoded information. The community-level measures for residential segregation or "redlining" will not be missing for a particular participant unless an address was not obtained or correctly geocoded during the interview process for SPEAC. Women without geocoded addresses will not be included in the final analyses.

From HMDA

Missing data for the HMDA will also be assessed. The issue of missing data for the race of the person applying for a loan will be handled by excluding loans that do not have data about race. About 14 percent of the data has missing information for the applicant's race. Previous studies have shown a range of 10-27% of all loans in the US between 1993 and 1999 that have missing race data (86). We cannot assume that race information is

missing at random although there are many explanations for missing race data in the HMDA (86).

After linking the birth file and geocoded information for the participated in SPEAC, 3949 women will be included in the final analysis. A total of 4880 women participated in the SPEAC, resulting in complete information for 81 percent of the women. Descriptive analyses will be conducted to determine if the final population differs from those excluded from the analysis due to missing data for the birth record and geocoded address.

Specific Aims and Analytic Strategy

The overall goal of this research project is to evaluate whether institutional racism and perceptions of discrimination, stress and neighborhood quality independently and jointly predict poor birth outcomes. SAS 9.2 software will be used for statistical analyses.

Overall Analytic Strategy

Descriptive Analyses

Univariate analyses will be conducted to derive frequencies for categorical variables and mean, median, mode, standard deviation and range for continuous variables for the outcome, main exposures and covariates. Outliers or extreme values will be assessed prior to regression analyses using plots to determine whether the values were implausible and if they should be retained. Missing values for each variable will also be assessed. Issues regarding handling missing data were described above. Further explanation of the analyses related to the specific aims and hypotheses is below.

Bivariate Associations

Bivariate analyses will be conducted to guide model construction for multilevel analyses and to assess the crude relationships between variables. The main exposure

variables (redlining and residential segregation) will remain as continuous variables in the regression analyses, but will be categorized into two or more categories based on appropriate cutpoints. Preterm/very preterm birth, the dichotomous form of the outcome of interest, will be assessed across the multiple levels of the exposures. The categorized variables with only two categories will be assessed using Pearson chi-square statistics and the Fisher exact tests when appropriate. The categorized variables with more than two levels will be assessed using the various types of exact tests for association (i.e. general association, mean score location shifts, nonzero correlation) (87). The chi-square statistic with a priori alpha level of 0.05 will be used to test if the associations are statistically significant. Further explanation of the analyses related to the specific aims and hypotheses is below.

Multivariate Multilevel Analyses

Since this is a cross-sectional survey linked with other administrative datasets, there are two levels of data (individual-level and community-level). Multilevel linear and logistic regression analyses will be used to determine the contribution of perceived stress, perceived discrimination, and institutional racism on birth outcomes (i.e. preterm birth and gestational age). The multilevel model accounts for clustering of individuals within communities (i.e. census tract) and employs estimation strategies to model within and between community-level effects. The advantages of the multilevel approach rather than the fixed effects approach is that the final models for determining risk of preterm birth, can include other community-level predictors, providing important contextual information. The PROC MIXED procedure in SAS will be used for the linear outcome and the PROC GLIMMX procedure in SAS will be used for the binary outcome.

Model assumptions will be evaluated and residual and sensitivity analyses will be employed. A graphical approach will be applied to evaluate the normality of residuals and homoscedasticity of residuals. Sensitivity analyses will also be conducted to determine whether extreme observations should be omitted. Prevalence odds ratios will be estimated for the multivariate multilevel analyses for the binary outcome (preterm birth), and average gestational age (continuous) will be determined as a function of the covariates. Random effects models will be estimated with intercepts specific to the unit of analysis (i.e. census tract) (39). The intraclass correlation (ICC) will be calculated for these models to determine whether the proportion of variance in the model is attributable to differences between communities (i.e. census tracts) (88). Further explanation of the analyses related to the specific aims and hypotheses is included in subsequent chapters.

CHAPTER 4: MANUSCRIPT 1

A Multilevel Approach for Developing a Measure for Residential Redlining as a Form of Institutional Racism in Public Health Research

Abstract

PURPOSE. Racial and ethnic inequities exist in many health outcomes, including perinatal health, and social-contextual factors may play an important role in these inequities. Institutional racism, where structures, policies and norms result in differential access to resources and power based on race, may play a major role in the etiology perinatal health inequities. This study outlines the process for constructing a residential redlining index as a form of institutional racism in housing and its application in public health research. **METHODS.** We used the Home Mortgage Disclosure Act (HMDA) database to create a residential redlining index by applying multilevel logistic regression analyses. Participants' addresses from the Stress Pregnancy and Evaluation Community Project (SPEAC) were geocoded and linked with the HMDA and 2000 US Census. The bivariate associations between redlining and residential segregation were assessed. The levels of residential redlining were mapped in Philadelphia County using ArcGIS. **RESULTS.** Residential redlining overlapped with the neighborhoods in which the SPEAC cohort lived where the majority of participants lived in redlined neighborhoods. There were significant differences in residence in redlined areas by race and ethnicity. However, redlining was moderately associated with residential segregation, depending on the index used, and the percentage of blacks on the census-tract level with correlation coefficients of 0.250 (dissimilarity) and

0.155 respectively. **CONCLUSION.** Residential redlining is a neighborhood contextual measure associated with residential segregation and may serve as an institutional measure of racism. Residential redlining exists within the neighborhoods among this cohort of pregnant women. In the future, this measure of residential redlining can serve as a neighborhood-level measurement for understanding health inequities among pregnant women and other populations.

INTRODUCTION

Racial and ethnic inequities exist for a range of health outcomes in the US. Contributing factors to these disparities have been proposed and examined in a multitude of studies. Some of the factors examined include health behaviors, genetics, socioeconomic status, healthcare services and stress (36). However, these factors do not completely explain the disparities we see in health, particularly in perinatal outcomes (36). Theorists and researchers have proposed that social and contextual factors are the fundamental causes of existing health racial and ethnic disparities in a society that historically and presently bases treatment, position, power and resources on a person's or group's social status (i.e. race, class, gender, sexual orientation and ability status) (8, 13, 36, 58, 74, 89, 90). Race, for example, captures the social classification of people in a race-conscious society (11). Race is not a biological construct but a social construct that captures the influences of racism (11, 91). Hence, it is important to examine social and contextual factors such as racism as fundamental in explaining racial differences in health.

Experiences of racism could act as a stressors with severe health consequences (9). Racism can come in the form of day to day experiences, also known as interpersonal racism as well as institutional racism and internalized racism (11). Everyday experiences of racism as a life stressor have been studied in relation to a variety of health outcomes such as birth outcomes, mental health outcomes, and chronic diseases (10, 12, 44, 47, 64, 92-96). Individual reports of racism and its association with health and birth outcomes have been investigated in several research studies including national studies such as the Behavioral Risk Factor Surveillance System (44, 56, 61-63). One of the first studies about experiences of racial discrimination and infant birth weight found an increased odds of very low birth

weight for women who reported discrimination (44). However, reports of racial discrimination could potentially vary by income or socioeconomic position (44, 61). On the other hand, institutional racism could influence health in the absence or presence of individual recognition of discrimination (11).

Institutional racism refers to the major policies, norms and institutions that result in differential access to resources and power based on race (11, 97). This can be the product of both overt and covert actions, resulting in a separation of racial groups, disinvestment in racially mixed or non-white communities, and directing investment and resources into homogenous, all-white communities (65). Forms of structural or institutional racism historically influenced health services, housing, education, employment, and attainment of wealth in the United States (11, 38, 74, 98, 99).

Although institutional forms of racism have implications for understanding social and contextual factors that contribute to health inequities, few studies have assessed its influence on health, well-being, morbidity and among various populations of color. Studies related to health have examined residential segregation as an institutional form of racism (12, 38, 100, 101). Researchers postulate that residential segregation is an institutional form of racism and a fundamental cause of disease difference between blacks and whites because it shapes social conditions for blacks at the individual and community levels (38, 68, 72). It manifests by creating social and physical risk in residential environments that have negative health consequences (38). Various neighborhood-level contextual factors have been researched in relation to many health outcomes, including residential segregation, neighborhood deprivation and neighborhood socioeconomic contexts, and have been hypothesized to be fundamental causes of disease (6, 33, 35, 42, 46, 72, 85, 102-105).

Residential redlining as a form of institutional racism is a neighborhood contextual measure that can be employed in health and social research to understand current health and social inequities (91). Residential redlining is a measure for institutional racism within communities that refers to discriminatory housing policies and practices which later results in black-white differences in wealth where housing equity is a major sources of wealth (38, 99). Redlining, also known as mortgage lending discrimination, is the practice in which banks and other financial institutions deny loans to people based on race (65, 70, 74, 99). In many cases, entire communities are denied loans or financial investments based on the racial composition of those communities (66, 74, 106). Housing discrimination and redlining are likely causes of residential segregation resulting in major differences in neighborhood environments (71).

To our knowledge, only one published study examined residential redlining in association with health (12). This study applied the Home Mortgage Disclosure Act (HMDA) database, which is a mechanism for reporting and measuring housing discrimination (12, 67, 68). A measure for residential redlining was produced with the HMDA by creating an index based on racial differences in loan disposition on the community level. The investigators evaluated redlining and mental health and general health outcomes among a population of Chinese-Americans (12). To our knowledge, no studies have investigated housing discrimination against blacks in the form of residential redlining in relation to perceived discrimination and its effects on perinatal health. Applying an index for redlining in order to understand the social context of pregnancy may provide insight into subsequent birth outcomes (7).

To address these gaps in the literature, we address several aims. First, this study outlines a method for developing a measure for residential redlining using multilevel logistic modeling. An "objective" measure of institutional racism in the form of residential redlining will be created. Second, this study examines the extent to which residential redlining and segregation exists in the neighborhoods where a cohort of pregnant women from the Stress Pregnancy and Evaluation Community Project (SPEAC) reside. Third, we examine the association between residential "redlining" and perceived discrimination among the entire SPEAC cohort and by racial/ethnic groups within this cohort. Finally, we map the redlined neighborhoods in Philadelphia County in which the women in SPEAC live. We hypothesized that there would be variation within the SPEAC cohort in the prevalence of residences in neighborhoods by level of redlining, residential segregation and perceived discrimination. We also hypothesize that residential redlining will be positively associated with perceived discrimination. In addition, black women followed by Latinas would more likely live in redlined and segregated areas and report discrimination compared to white women.

METHODS

Data Sources

This study links data from the Stress Pregnancy and Evaluation Community Project (SPEAC), Pennsylvania vital birth records, the Home Mortgage Disclosure Act (HMDA) database and the US Census. The SPEAC survey was from 1999-2004 by the Department of Obstetrics and Gynecology at Jefferson Medical College, Thomas Jefferson University to investigate the relationship between chronic maternal stress and bacterial vaginosis (BV) for pregnant women enrolled at the time of their first prenatal clinic visit. The women received

prenatal care from one of eight Philadelphia District Health Centers and two hospital-based clinics. Inclusion criteria for the SPEAC study were singleton gestation, intrauterine pregnancy, and English or Spanish speaking (25). All women regardless of foreign born status will be included in the initial analysis. The average gestational age at the time of BV screening and stress assessment was 14.8 weeks (26). This SPEAC survey includes information about the women's individual health, reports of stress and discrimination, demographic information, the census tracts in which they lived when the survey was collected, and the linked vital birth records. A total of 4880 pregnant women completed the SPEAC survey. Women who had miscarriages, still births or abortions would not have a birth certificate. As a result, survey information for 4130 (85%) SPEAC participants were successfully matched with the birth file. Out of those women, 3949 (81% of the 4880) had linked birth records and geocoded addresses and are included in the final analysis for this study.

The Home Mortgage Disclosure Act (HMDA) is an administrative database created by the Federal Reserve Board that collects yearly information from banks and other lending institutions providing mortgage loans. The residential redlining construct is derived from the HMDA for years 1999-2004. This dataset contains all loan dealings from financial institutions throughout the United State for a particular year and includes information about type and amount of loan, census tract of the property, loan disposition and characteristics of the applicant. This study excludes (1) incomplete applications that were not processed by lending institutions and therefore could not be part of a measure for loan disposition bias; (2) properties that are not owner-occupied (3) home improvement loans; and (4) multi-family units (12). The analysis for this study only includes mortgage loans with information about

the applicant's race and only those identified as black or white race. An index of residential redlining was created for each census tract in Philadelphia County and later linked with the census tracts in which the women lived who completed the Stress Pregnancy and Evaluation Community Project (SPEAC) survey. An average of 16,527 loans per year were included in the HMDA database between 1999-2004 in the analytic sample in Philadelphia County.

The third data source is the year 2000 US Census. The US Census was used to derive a measure for residential segregation based on the index of dissimilarity for each neighborhood in which the women in SPEAC lived.

Neighborhood Definition

Although block group level data is available from the US Census and the SPEAC data, the smallest neighborhood unit included in the HMDA database is the census tract. As a result, the definition of neighborhood for this study will be the census tracts within Philadelphia County. The addresses of women who participated in SPEAC were geocoded and assigned a census tract based on the US 2000 census boundaries.

Deriving an Index for Redlining

Outcome. *Loan action taken*, (accepted/denied), describes whether or not a loan was denied by a financial institution, will be used to create the redlining measure. There was an average of 1.7 percent per year between 1999 and 2004 of missing data for this variable among the analytic sample. This variable is derived from the HMDA database.

Main Predictor. The *race* of the loan applicant will be the main predictor of loan disposition in this study. The redlining index is operationalized as black-white loan disposition and hence includes those who identified themselves as black or white. Loans that were missing information about the applicant's race were not included in the analysis. Race

data is missing either because the race was not provided by the applicant or loan officer or because the applicant's race was not applicable if a financial institution rather than an individual purchased the loan. After exclusions were applied, an average of 15.32 percent per year over the six year period had missing information for the primary applicant's race.

The covariates included in creating the index for redlining are the sex of the applicant, the applicant's gross annual income, and the loan amount. These covariates were chosen based on conceptual models and previous studies utilizing HMDA data to report housing discrimination (12, 106-108). The applicant's gross annual income and the loan amount are reported in thousands of dollars and are continuous variables. Other important information such as the applicant's credit score or employment status were not included in the HMDA database so could not be included as covariates. The final multilevel logistic regression model employed to create the final redlining measure is described within the statistical analyses section.

Final Redlining Index

A redlining index was created using the HMDA for each neighborhood (i.e. census tract). The redlining indices were created for each year for all relevant census tracts for Philadelphia County. Final indices are odds ratios for each census tract based on multilevel logistic regression models. The redlining index scores ranged from 0.31 to 6.82 with a mean score of 1.95 and a median score of 1.88. A score of 2.0 indicates a neighborhood where the odds of loan denial among blacks are twice the odds of loan denial among whites. Previous studies categorized the redlining index at the point where minority loan applicants were disfavored by 40 percent compared to whites (12, 90, 109). However, various categorical forms of the index were examined in relation to gestational age and preterm birth for this

study. Analyses demonstrated there were no significant differences in the selection of cutpoints within this population. As a result, the various categorical and continuous forms of this index will be evaluated in this study. For reporting purposes, indices with a threshold of 1.4 will be presented. Redlined areas in this paper are operationalized as census tracts with a redlining index of greater than or equal to 1.4. Areas labeled as "Other" are census tracts with a redlining index less than 1.4. Future multivariate health models involving the redlining index will utilize the continuous measure.

Additional Measures

The following measures included in this study are derived from the US Census and the Stress Pregnancy and Evaluation Community Project (SPEAC).

Residential Segregation. The *Index of Dissimilarity* is a measure of residential segregation that quantifies the proportion of Blacks that would have to change their area of residence to achieve an even distribution of the population in census tracts (84). The index of dissimilarity is calculated as follows:

$$\mathbf{D=} \sum_{i=1}^{n} [\{t|p-P|\}/\{2TP(1-P)\}]$$

Where t and p represent the total population (t) and minority proportion (p) of area unit i (block); and T and P represent the total population (T) and minority proportion (P) of the larger area unit. This index measures the level of evenness or differential distribution of groups across areal units (84). This index ranges from 0 to 1 and is a continuous measure stemming from the US Census and linked to the geocoded addresses of the women from the SPEAC study. This will be the primary residential segregation index used in this study. Additional segregation indices included in the study are the exposure index and the isolation index. The exposure index measures the extent to blacks are exposed to whites. The higher

numbers indicate a lower degree of segregation. The isolation index measures the extent to which blacks are only exposed to one another. Higher values indicate a greater degree of segregation (84).

Perceived Discrimination. SPEAC participants were asked about *perceived discrimination* based on everyday experiences of discrimination and major experiences of discrimination. Respondents were asked to rate the frequency of day to day experiences of discrimination because of "race, ethnicity, income level, social class, sex, gender, age sexual orientation, physical appearance or religion" (82). These experiences were rated on a six-point scale ranging from "never" to "almost every day." The total score was summed and analyses were conducted to determine the distribution of the scores and appropriate categorizations of the measure. The scores ranged from 0 to 43. The summed score was then categorized by level of discrimination: none (0 points), low (1-10 points), medium (11-20 points), high (21+ points). This was referred to as the *everyday discrimination* measure. These cutpoints were based on the cluster of individuals that had a score of zero and approximate intervals of 10 for the remaining categories. A sensitivity analysis was also conducted to examine if mean redlining scores varied based on the choice of categorizations for the perceived discrimination score (results not shown). The continuous form of this scale and the categorized form were evaluated in this study. Respondents were also asked to answer "yes" or "no" to two questions about *major* experiences of discrimination. Those questions were: 1) "For unfair reasons, do you think that you have ever not been hired for a job?" and 2) "Have you ever been unfairly stopped, searched, questioned, physically threatened or abused by police?" These two questions were added together, resulting in 0, 1 or 2 major events. This was referred to as the *major discrimination* measure.

Maternal Race/Ethnicity. SPEAC participants were asked to identify their race, which also included an option of Hispanic ethnicity. The classifications included in this study are non-Hispanic white, non-Hispanic black, Hispanic/Latina, Other.

Statistical Analyses

Deriving the Redlining Measure. The final redlining measure was calculated by using multilevel logistic models to account for clustering of individual loans within census tracts. The census tract served as the neighborhood unit. To assess the variability in redlining across census tracts, an intercept only model with random intercepts was run to calculate the intraclass correlations (ICC). The ICC is computed to determine the variance between and within census tracts. A low ICC indicates little variation in redlining across neighborhoods compared to the variation in redlining within neighborhoods. Full models were then run to create Empirical Bayes' estimates for each census tract for the black-white difference in denial of loans after adjusting for all other covariates. The covariates were initially chosen based on previous studies using this data and theoretical frameworks instead of significance tests. However, when examining significance tests for the covariates included in the models, these covariates ranged in their level of significance from 1999-2004. As a result, we decided to maintain these covariates in the models regardless of the year the loan was purchased. The estimates produced from the models allow us to detect a black-white racial difference in loan disposition as a function of other covariates, which is the operationalization of redlining for this study. The full model is as follows:

Level 1 equation:

$$\text{Log}\left[p_{ij}/(1-p_{ij})\right] = \beta_{0j} + \beta_{1j}(\text{race})_{1ij} + \beta_{2j}(\text{gross annual income})_{2ij} + \beta_{3}(\text{loan amount})_{3ij} + \beta_{4}(\text{sex})_{4ij} + r_{1ij}$$

Level 2 equation:

$\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta_{1j} = \gamma_{10} + u_{1j}$

$$\begin{bmatrix} u_{oj} \\ u_{1j} \end{bmatrix} \sim N\left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} t_{oo} \\ t_{01} t_{11} \end{bmatrix}\right)$$

Final Model:

$\text{Log}\,[p_{ij}/(1-p_{ij})] = \gamma_{00} + \gamma_{10}\,(\text{race})_{1ij} + \beta_{2j}(\text{gross annual income})_{2ij} + \beta_{3j}(\text{loan amount})_{3ij} + \beta_4(\text{sex})_{4ij} + u_{0j} + (\text{race})_{1ij}\,u_{1j}$,

where *i* is an index for individuals and *j* is an index for census tracts. The outcome to be examined is the natural log odds of being denied a loan (p, probability of event) where u_{0j} is the random effect for census tract j. We assume the random effects for the intercept and slope are normally distributed with means of zero, variance of τ_{00} for the intercept and τ_{10} for the slope and covariance of τ_{11}.

The final index places each census tract along a continuum of mortgage loan discrimination (redlining). The redlining indices for the census tracts in Philadelphia County were compared across years to see if there were any significant mean changes in redlining between 1999 and 2004. A correlation matrix was used to compare the Empirical Bayes' estimates of the random effects models for redlining in Philadelphia County over the six year period. The correlations of the estimates across the six year period ranged from 0.197 to 0.321, suggesting that the estimates changed quite a bit across the years. Since there were also trend changes in the mean redlining index over the six year period, the final redlining measures for the year in which the woman completed the SPEAC survey was linked to the census tract in which she lived. The distribution of Beta estimates for the model intercepts

and slopes for race and corresponding odds ratios were also explored through graphical analyses. The GLIMMIX Procedure in SAS 9.2 was used to conduct these analyses.

Additional Analyses. Univariate analyses were conducted to assess the distribution and frequency of redlining, residential segregation, and perceived discrimination for the overall SPEAC cohort and by race/ethnicity. Bivariate associations between race/ethnicity and selected population characteristics such as redlining and perceived discrimination were assessed using chi-square, Mantel-Haenszel, and Fisher statistics. Bivariate associations were also assessed between the categorized version of the redlining variable and other population characteristics. We used SAS 9.2 for the statistical analyses.

GIS Mapping

The measures for residential redlining for each census tract in Philadelphia County were mapped using ArcGIS. The spatial maps include the various levels of the residential redlining index for years 1999-2004. The map for the year 2000 is included in this paper and the additional maps for the remaining years are included in Appendix A.

RESULTS

In developing the index of residential redlining, we explored the basic characteristics of the mortgage loans included in HMDA. A range of 8 to12.1 percent of mortgage loans were denied between 1999 and 2004 (Appendix A, Table A.1). A majority of the loan applicants were white and male. The majority of the loans applied for between 1999 and 2004 were conventional loans followed by FHA-insured loans, VA-guaranteed loans and then Farmer's Home Administration loans. The mean income of loan applicants in 1999 was almost $47,000 and increased slightly each year. Additional descriptive characteristics of mortgage loans are included in Appendix A.

We evaluated the crude relationship between race and loan disposition among loan applications in Philadelphia County (Table 4.1). Based on the crude associations, we found that the average black applicant was more likely to be denied a loan compared to a white applicant for all six years (1999: OR=2.16, 95% CI: 1.96, 2.39; 2004: OR=2.51, 95% CI: 2.30, 2.74). When controlling for loan type, we found a slight elevation in the odds of denial among black applicants compared to white applicants for conventional loans (OR ranged from 2.96 (95% CI: 2.70, 3.25) to 3.78(95% CI: 3.32, 4.29)) (results included in Appendix A).

Table 4.2 includes descriptive characteristics of the SPEAC population by race/ethnicity and in relation to residential redlining. The majority of the SPEAC participants were non-Hispanic black women followed by Latinas/Hispanic women, non-Hispanic white women and women of other racial/ethnic groups. The majority of the SPEAC population (77.5 percent) lived in redlined areas, meaning they lived in neighborhoods where blacks were 1.4 times or more likely to be denied a mortgage loan compared to whites. Almost 80 percent of the non-Hispanic black women, 71 percent of Latinas/Hispanic women, 75 percent of non-Hispanic white and 69 percent of women from another race lived in redlined neighborhoods (results not shown). Black non-Hispanic women were overrepresented in redlined areas compared to other racial/ethnic groups. Latina/Hispanic women were underrepresented in redlined areas compared to other racial/ethnic groups. There were slight differences in the mean redlining index across racial/ethnic groups, which were statistically significant. Black non-Hispanic women had highest mean redlining score of 2.0 followed by non-Hispanic white women (1.92) then

Hispanic women (1.83). The redlining scores ranged from 0.31 to 6.82 for all women in the SPEAC cohort.

There were statistically significant differences in total household income across racial/ethnic groups; however, there were no differences in income by level of residential redlining (Table 4.2). There were statistically significant differences in reports of everyday and major discrimination scores across racial/ethnic groups; however, there were no differences in reports of discrimination by level of redlining. There were statistically significant racial/ethnic differences in residences in neighborhoods by level of segregation and percentage black. Based on the dissimilarity index, white women from the SPEAC sample were more likely to live in segregated neighborhoods with a mean index score of 0.49. For the exposure index, blacks from the SPEAC sample were more likely to live in segregated areas with a mean index score of 0.11. Finally, for the isolation index, blacks were more likely to live in segregated neighborhoods with a mean index score of 0.79. Blacks in the SPEAC sample lived in neighborhoods with the highest percentage of black residents with a mean percentage of 74 percent compared to all other racial/ethnic groups in the SPEAC sample. There were positive associations between residential redlining and the three segregation indices and percentage black at the census tract level for all women and by race and ethnicity (Table 4.3).

Figure 4.1 is a map of residential redlining across the various census tracts in Philadelphia County during the year 2000. The darker regions indicate the highest levels of residential redlining and lighter regions indicate the lowest levels of residential redlining. Center City and Lower North Philadelphia are characterized by having low levels of redlining with the lighter shades towards the middle of the map. There are a few pockets of

the highest levels of redlining throughout Philadelphia with the regions of Far Northeast Philadelphia also having neighborhoods with redlined indices greater than 3. The aforementioned locations are based on Philadelphia's Planning Analysis Sections (110).

DISCUSSION

This study was developed to explore the use of the Home Mortgage Disclosure Act dataset, an administrative dataset, to create a community-level measure of residential redlining. Similar to the use of the US Census in creating community-level measures such as residential segregation, economic deprivation and neighborhood deprivation, residential redlining can provide neighborhood contextual information important for understanding health inequities (12, 68, 74, 111-113). Applying multilevel logistic regression models with random slopes for race allowed us to detect the black-white differences in loan disposition after controlling for important covariates for each census tract included in the study. Applications of these models allows us strengthen our census-specific estimates for redlining by also optimizing information across census tracts (114). Similar to the value-added models applied in educational research (115, 116), this technique fits the model and produces Empirical Bayes' estimates specific to each census tract in Philadelphia County.

In developing the redlining index, we discovered low temporal stability in estimates over the six year period (1999-2004) of the SPEAC study. The possible reasons for the low temporal stability could be due to an actual shift in redlining over the 6 year period or possible measurement error. Measurement error was evaluated by separately examining estimates generated from census tracts with low number of loans and high numbers of loans to see if there was instability in the estimates. However, we found no significant differences in temporal stability. In educational research, it is argued that value-added models are best

when averaged over multiple years (116). However, in this case, averaging over the six years would entail applying loan disposition estimates to a woman's neighborhood when she may not have lived there. For example, a woman who participated in the study in 1999 would have an averaged redlining index that included information for 1999-2004. This would assume that the woman lived in that neighborhood for several years after participating in the study when she could have potentially moved. As a result, we linked the HMDA estimates for the redlining index with the year in which the women in SPEAC participated in the study rather than an average over the six year period. This allowed us to obtain a snapshot of redlining for that woman at that particular time. Subsequent chapters examine the use of this measure in relation to specific outcomes such as preterm birth as well as perceptions of stress.

We generally found that residential redlining existed in the neighborhoods in which the women in SPEAC lived. Although the redlining indices ranged from 0.3 to 6.8 in this population, the majority of participants lived in redlined neighborhood, and the mean redlining index for the population was almost 2. This demonstrates that participants may be clustered in certain areas in Philadelphia County that are characterized as having institutional racism, potentially suggesting less variability in redlining among this population. When evaluating redlining specifically within the SPEAC cohort, we found that black women were significantly overrepresented in redlined neighborhoods versus other neighborhoods. Our hypothesis was supported that non-Hispanic black women would be more likely to live in redlined neighborhoods. The possible reasons for this effect are that non-Hispanic blacks as individuals and black communities in general have been historically subject to discrimination in housing and the mortgage industry (68, 70, 71, 101, 106, 117). Although the racial/ethnic

differences in mean redlining indices are slight, differences in redlining may be an important neighborhood characteristic for understanding racial/ethnic health inequities and the social context in which pregnant women live (118). Our hypothesis was not supported that non-Hispanic black women would live in more segregated areas as measured by the index of dissimilarity. Actually, non-Hispanic white women had the highest dissimilarity index. This could suggest that the non-Hispanic white women in the SPEAC study tend to live in neighborhoods (i.e. census tracts) where the non-Hispanic black population is segregated. However, the overall SPEAC population tends to live to in less segregated census tracts compared with the overall population in Philadelphia as measured by the black-white index of dissimilarity (68).

Residential redlining was not associated with everyday experiences of discrimination or major experiences of discrimination. Both perceived discrimination measures were based on self-report and we were interested in whether self-reports on the individual level were associated with the institutional level. There are several possible explanations for this lack of association. First, the measure of discrimination included in this study was not limited to experiences of discrimination based on race/ethnicity but included other social identities such as gender, class and sexual orientation. Previous studies investigating discrimination and health have focused on unfair treatment due to race/ethnicity and the discrimination instrument employed in this study may not be as precise. As a result, the association between institutional racism and perceived discrimination based on various social identities may be washed out. A second explanation is that the institutional and perceptions measures are capturing different constructs and do not overlap, possibly suggesting the importance of both measures. Third, there may be possible intermediary factors influencing the relationship

between institutional racism and perceptions of discrimination. Our hypothesis was supported that non-Hispanic black women would be most likely to perceive discrimination compared to other racial/ethnic groups. This finding has been supported in other studies, although coping styles and individual socioeconomic status have influenced peoples' reporting of discrimination (62, 119-122).

Finally, residential redlining was associated with other neighborhood level constructs included in this study. Redlining was associated with a greater black dissimilarity residential segregation index score among the SPEAC cohort. Residential segregation has been suggested as the "cornerstone" on which racial and ethnic inequities have been built and residential redlining has been noted as a major contributor to existing residential segregation (38, 65, 73). Redlining was also associated with a greater percentage of blacks on the census-tract level among the SPEAC cohort. Although these community-level constructs were associated, their correlations were small. This suggests that the residential redlining index included in this study is capturing a separate construct from black-white dissimilarity and percentage black.

This study has a few limitations. First, the HMDA dataset used to create a measure of redlining does not include information about an applicant's employment status, debt to income ratio or credit scores, all which are important in loan disposition (117). These factors may be important in understanding black-white differences in loan disposition and mortgage discrimination (117). It was not until 2004 that HMDA reporting requirements included information on the difference between the annual percentage rate (APR) and the a comparable treasury rate or rate spread, which was released in 2005 (106). The years 2000 to 2003 were characterized by low subprime loans, improvement in mortgage delinquencies and

an increase in mortgage originations with a peak in 2003 (106). Between 2004 and 2006, data showed that minority borrowers were to pay higher APR's than minority borrowers, indicating that lends may have participated in a practice of discriminatory lending with respect to the pricing of home mortgage loans (106). The market shifted with the subprime lending market growing at a rapid pace around this time (106). All of these factors could have potentially had an effect on the actual redlining constructs developed in this study. Additionally, the HMDA alone may not be adequate for measuring discrimination in home mortgage lending and may need to be combined with other quantitative and qualitative measures of borrowers and lending institutions (106, 117). Second, the measures for perceived discrimination are based on self-report. Reporting bias is characteristic and challenge of public health and behavioral research. If reporting of discrimination varies by race/ethnicity within this particular study, we could potentially over or underestimate perceived discrimination and ultimately its association with residential redlining.

Another challenge in neighborhood research is the use of administrative units such as census tracts to define neighborhoods. The smallest unit of analysis included in the HMDA is the census tract so data analysis is driven by this administrative cluster. However, studies in children's health and perinatal health have concluded that using smaller block group administrative units versus census tracts yielded similar results, although use of zip codes were more problematic (118, 123).

Missing race data may also pose as a challenge in effectively estimating redlining. After applying specific exclusion criteria for the HMDA analytic sample, approximately 14 percent of the loans were missing data for race. Using data from 1993-1999, one study found that race data were missing for systematic reasons and that applications from Blacks and

Hispanics may be more likely to be without race data than whites (86). This suggests that denial rate disparities may be underestimated (86).

Although this study has a few limitations, there are multiple strengths. This is the first study to apply measures of redlining among a cohort of racially diverse pregnant women. One previous study examined residential redlining among a cohort of Chinese-Americans in California (12). We created this redlining construct by applying multilevel logistic regression models in order to capture a woman's neighborhood and social environment without dependency on self-reports. The previous health study applying the HMDA data used fixed effects logistic models for each census tract and had to use estimates from adjacent tracts if a particular tract had insufficient numbers of loans (12). We were also able to acquire estimates for residential redlining over a six year period, rather than only one year, strengthening the methods applied in the previous study. Additionally, the residential redlining index measures a construct that is separate and different from perceptions of discrimination as measured in this study as well as commonly used measures for residential segregation and percentage black from the US Census. Finally, the Home Mortgage Disclosure Act (HMDA) dataset is a public administrative database that is useful for monitoring and measuring residential redlining (124). Future studies can apply institutional measures such as redlining in several contexts.

In conclusion, this study highlights residential redlining as a construct to measure institutional racism that may provide insight into factors contributing to racial/ethnic inequities in health and other outcomes. The redlining construct allows for measuring neighborhood-level effects on health and provides an opportunity to evaluate individual and contextual risk factors simultaneously. Moreover, the methods present in this study provides

an avenue for multidisciplinary research and work in the areas of housing, neighborhood development, regional planning and public health aimed at eliminating inequities. Future studies should incorporate residential redlining and multilevel analyses in order to elucidate the influence of individual and institutional level discrimination on various health outcomes and to potentially eliminate health related inequities.

TABLES

Table 4.1: Crude relationship between loan denial and applicant's race including the odds ratio and 95% confidence interval, HMDA 1999-2004

Loan Denied									
	1999			2000			2001		
	Yes	No	Odds Ratio (95% C.I.)	Yes	No	Odds Ratio (95% C.I.)	Yes	No	Odds Ratio (95% C.I.)
Applicant's Race									
Black	1122	5436	2.16 (1.96, 2.39)	1160	5950	2.18 (1.98, 2.41)	774	4873	2.05 (1.83, 2.29)
White	769	8063		738	8258		590	7606	
Total N	1891	13499		1898	14208		1364	12479	
	2002			2003			2004		
	Yes	No	Odds Ratio (95% C.I.)	Yes	No	Odds Ratio (95% C.I.)	Yes	No	Odds Ratio (95% C.I.)
Applicant's Race									
Black	616	4815	1.92 (1.70, 2.16)	955	5234	2.29 (2.07, 2.53)	1163	5014	2.51 (2.30, 2.74)
White	574	8604		824	10344		1180	12776	
Total N	1190	13419		1779	15578		2343	17790	

Table 4.2: Selected Characteristics of the SPEAC Population by Race/Ethnicity and Association with Residential Redlining, SPEAC 1999-2004

		Race/Ethnicity				Redlining, Continuous Measure	Redlining, Categorized Measure (>=1.4)	
Characteristic	**Total**	**Black (non-Hisp)**	**White (non-Hisp)**	**Latina /His-panic**	**Other**	**Redlining, mean (SD)**	**Red-lined, N(%)**	**Other, N(%)**
Race/Ethnicity, N(%)								
Black (non-Hispanic)	2661 (67.44)	--	--	--	--	2.00 (0.75)	2104 (69.58)	520 (59.36)***
White (non-Hispanic)	364 (9.22)	--	--	--	--	1.92 (0.85)	270 (8.93)	92 (10.50)
Latina/Hispanic	803 (20.35)	--	--	--	--	1.83 (0.69)	569 (18.82)	228 (26.03)
Other	118(2.99)	--	--	--	--	1.88 (0.74)***	81 (2.68)	36 (4.11)
Age, mean (SD)	24 (5.7)	24 (5.8)	24 (5.3)	24 (5.2)	25 (6.3)	--	24.04 (5.69)	24.27 (5.66)
Total Household Income, N(%)								
Under $5,000	718 (20.28)	389 (16.28)	34 (11.33)	276 (36.85)	18 (18.18)***	1.92 (0.73)	532 (19.67)	173 (21.87)
$5,000-9,999	526 (14.86)	347 (14.52)	29 (9.67)	136 (18.16)	14 (14.14)	1.98 (0.74)	404 (14.92)	113 (14.29)
$10,000-14,999	470 (13.28)	323 (13.51)	40 (13.33)	86 (11.48)	21 (21.21)	1.98 (0.74)	366 (13.53)	97 (12.26)
$15,000-19,999	444 (12.54)	300 (12.55)	44 (14.67)	88 (11.75)	12 (12.12)	1.90 (0.72)	354 (13.09)	86 (10.87)
$20,000-24,999	413 (11.67)	306 (12.80)	43 (14.33)	50 (6.68)	14 (14.14)	1.99 (0.81)	314 (11.61)	95 (12.01)
$25,000-29,999	292 (8.25)	219 (9.16)	22 (7.33)	43 (5.74)	8 (8.08)	1.84 (0.73)	206 (7.62)	83 (10.49)
$30,000-34,999	246 (6.95)	184 (7.70)	22 (7.33)	34 (4.54)	6 (6.06)	1.95 (0.79)	194 (7.17)	50 (6.32)
$35,000-39,000	148 (4.18)	116 (4.85)	16 (5.33)	14 (1.87)	1 (1.01)	1.96 (0.70)	110 (4.07)	36 (4.55)
$40,000+	283 (7.99)	206 (8.62)	50 (16.67)	22 (2.94)	5 (5.05)	1.96 (0.72)	225 (8.32)	58 (7.33)
Continuous Everyday Discrimination Score, mean (SD)	5.0 (6.98)	5.26 (7.15)	3.74 (6.17)	4.70 (6.80)	5.19 (6.43)***	--	4.98 (6.95)	5.14 (6.95)

		Race/Ethnicity				Redlining, Contin-uous Measure	Redlining, Categorized Measure (>=1.4)	
Characteristic	**Total**	**Black (non-Hisp)**	**White (non-Hisp)**	**Latina /His-panic**	**Other**	**Redlining, mean (SD)**	**Red-lined, N(%)**	**Other, N(%)**
Major Discrimina-tion, N(%)								
No Events	3238 (82.31)	2162 (81.49)	312 (86.19)	658 (82.25)	104 (88.89)*	1.95 (0.75)	2491 (82.57)	712 (81.75)
One Event	600 (15.25)	414 (15.60)	42 (11.60)	132 (16.50)	12 (10.26)	1.91 (0.72)	453 (15.01)	137 (15.873)
Two Events	96 (2.44)	77 (2.90)	8 (2.21)	10 (1.25)	1 (0.85)	2.06 (0.79)	73 (2.42)	22 (2.42)
Residential Redlining, N(%)						–	–	–
0-1	330 (8.5)	202 (7.7)	40 (11.1)	74 (9.28)	–	–	–	–
>1-2	1964 (50.4)	1269 (48.4)	178 (49.2)	462 (58.0)	–	–	–	–
>2-3	1246 (31.9)	891 (34.0)	111 (30.7)	206 (25.9)	–	–	–	–
>3-4	313 (8.0)	229 (8.7)	25 (6.9)	49 (6.2)	–	–	–	–
>4-5	40 (1.0)	29 (1.11)	5 (1.4)	6 (0.8)	–	–	–	–
>5-6	3 (0.08)	1 (0.04)	2 (0.6)	0 (0)	–	–	–	–
>6-7	4 (0.1)	3 (0.11)	1 (0.3)	0 (0)	–	–	–	–
NH-Black dissimilarity index score, mean (SD)	0.40 (0.13)	0.40 (0.12)	0.49 (0.17)	0.35 (0.12)	0.42 (0.15)***	–	0.41 (0.13)	0.35 (0.13)***
NH-Black exposure index score, mean (SD)	0.17 (0.24)	0.11 (0.17)	0.53 (0.25)	0.22 (0.24)	0.31 (0.28)***	–	0.14 (0.23)	0.25 (0.24)***
NH-Black isolation index score, mean (SD)	0.64 (0.32)	0.79 (0.26)	0.27 (0.22)	0.35 (0.22)	0.49 (0.31)***	–	0.67 (0.32)	0.52 (0.31)***
Percent Black in census tract, mean (SD)	58% (36%)	73.70 (29.41)	16.52 (21.89)	27.39 (21.81)	40.71 (32.56) ***	–	61.32 (35.81)	46.27 (33.13)***
Total SPEAC participants, N(%)	–	–	–	–	–	–	3026 (77.53)	877 (22.47)

***p<0.05; **p<0.01; ***p<0.001**

Table 4.3: Pearson Correlations of Residential Redlining and Other Community-Level Variables, SPEAC 1999-2004

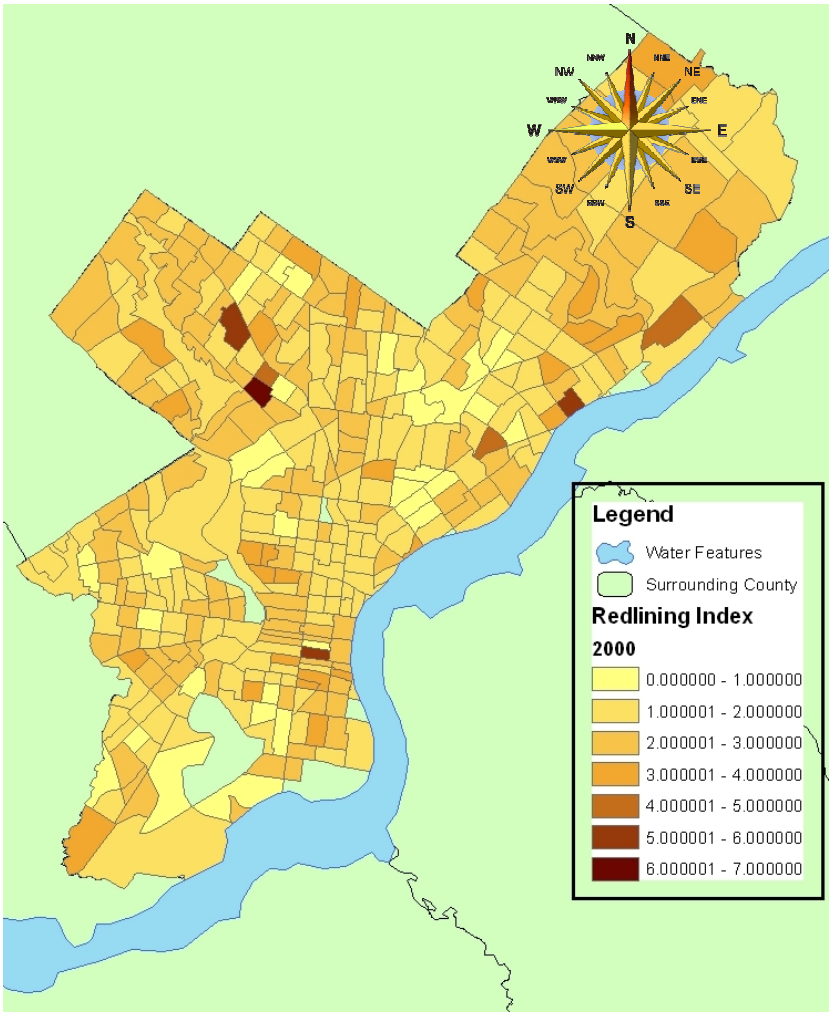
All Women					
	Residential Redlining	**Percent Black, census tract**	**Segregation: NH-Black Dissimilarity Index**	**Segregation: NH-Black Exposure Index**	**Segregation: NH-Black Isolation Index**
Residential Redlining	1				
Percent Black, census tract	0.155***	1			
Black Dissimilarity Index	0.250***	-0.01648	1		
Black Exposure Index	-0.115***	-0.766***	0.176***	1	
Black Isolation Index	0.174***	0.986***	0.0782***	-0.776***	1
Non-Hispanic Black Women					
Residential Redlining	1				
Percent Black, census tract	0.184***	1			
Black Dissimilarity Index	0.216***	0.0724***	1		
Black Exposure Index	-0.154***	-0.824***	-0.0449*	1	
Black Isolation Index	0.203***	0.983***	0.192***	-0.837***	1
Non-Hispanic White Women					
Residential Redlining	1				
Percent Black, census tract	-0.108*	1			
Black Dissimilarity Index	0.403***	-0.324***	1		
Black Exposure Index	0.128*	-0.789***	0.410***	1	
Black Isolation Index	-0.0249	0.945***	-0.175***	-0.830***	1

Hispanic Women					
	Residential Redlining	**Percent Black, census tract**	**Segregation: NH-Black Dissimilarity Index**	**Segregation: NH-Black Exposure Index**	**Segregation: NH-Black Isolation Index**
Residential Redlining	1				
Percent Black, census tract	0.0607	1			
Black Dissimilarity Index	0.260***	-0.0193	1		
Black Exposure Index	-0.152***	-0.515***	0.220***	1	
Black Isolation Index	0.106*	0.965***	0.157***	-0.518***	1

***p<0.05; **p<0.01; ***p<0.001**

FIGURES

Figure 4.1: Map of Residential Redlining in Philadelphia County, Pennsylvania, HMDA 2000



CHAPTER 5: MANUSCRIPT 2

Residential Redlining and Racial/Ethnic Differences in Perceptions of Discrimination, Stress and Neighborhood Quality Among Pregnant Women in Philadelphia, PA

Abstract

PURPOSE. Residential redlining, a systematic form of housing discrimination, is a form of institutional racism that has resulted in differential access to resources and power for minority communities. Residential redlining could have tremendous effects on perinatal health, acting as an external stressor. This study was designed to assess the relationship between residential redlining and perceptions of discrimination, stress, and neighborhood quality as well as racial/ethnic differences in these perceptions among a cohort of pregnant women. **METHODS.** We conducted a secondary analysis of a cohort of 3,949 pregnant women from the Stress Pregnancy and Evaluation Community Project (SPEAC). Perceptions of discrimination, stress, and neighborhood quality were measured at the individual level through interviews. An index for residential redlining was constructed using the Home Mortgage Disclosure Act (HMDA) database. Multivariate linear regression models were conducted to examine the relationships between residential redlining and perceptions of stress, discrimination and neighborhood quality. **RESULTS.** SPEAC participants lived in neighborhoods where blacks were 1.9 times as likely as white to be denied a mortgage loan as measured by the index of residential redlining. Black non-Hispanic women had a greater mean residential redlining index, greater perceived everyday discrimination score, and more adverse ratings of neighborhood quality compared to women

of all other racial/ethnic groups. Residential redlining was positively associated with perceived poor neighborhood quality ($b=2.5$, $p<0.01$). Residential redlining was not associated with perceived discrimination or stress for the overall SPEAC population. However, residential redlining was associated with perceived discrimination ($b= -1.16$, $p<0.01$) among non-Hispanic white women only. Residential redlining is moderately associated with percent black on the census tract level and residential segregation.

CONCLUSION. Residential redlining is a strong predictor of perceived poor neighborhood quality, stress and discrimination for specific racial/ethnic subgroups. Understanding institutional forms of racism and its effects on perceptions of stressors for pregnant women may provide insight into contributing factors to racial/ethnic disparities in perinatal health.

INTRODUCTION

Stress is a multidimensional construct that involves person-environment interactions and the conflicts between environmental demands and the individual's biological, psychological or social resources (48). Some literature shows that chronic stress has been associated with several adverse perinatal outcomes such as low birth weight and preterm birth, yet this association has not been firmly established (47, 48, 50, 52-56). The physiologic load created by chronic exposure to stress accumulates over time, leading to an enhanced inflammatory response, and contributing to the poorer health outcomes that may be associated with particular populations (49-51).

Stress can be influenced by social factors and therefore must be put in their proper context to truly understand the full range of factors that are at play in creating increased risk (58). The "weathering" hypothesis suggests that increased maternal age among African American women reflects the compounding effects of social inequality, racial discrimination, and exposure to psychosocial or environmental hazards over the lifespan leading to growing gaps in maternal and fetal health (57, 125). As a result, the health status of African American women begins to deteriorate at a more accelerated rate compared to other populations as a result of a prolonged insult on the body as well as coping with stressful experiences over long periods of time (57).

There are stressors that are unique to populations of color that may contribute to the disparities we see in perinatal health. Psychosocial factors, particularly perceived stress and discrimination, have been examined as individual factors in association with maternal health and birth outcomes and as plausible contributors to health inequities (20, 36, 44, 46, 54, 56, 59, 94, 126-128). For example, experiences of racism are a unique and distinct set of

stressors experienced by black women in the US and may result in adverse health outcomes for pregnant women. Racism operates as a psychological stressor embedded in the multiple contexts shaping the lives of women of childbearing age, and the ways in which race is "lived" and understood are under constant change (60).

Psychosocial stress as a direct result of the social, contextual environment could also potentially contribute substantially to the racial and ethnic inequities in perinatal health (5, 20, 36, 54, 64, 101, 128). Neighborhood contextual factors are suggested to contribute to health outcomes and adverse neighborhood factors have been examined in many studies as contributors to disparities in health. Neighborhoods or communities that experience high rates of crime, exposure to environmental toxins, lack of health resources, limited amounts of fresh produce and healthy foods, inadequate and safe housing, and joblessness have been found to have an effect on health outcomes and health behaviors (35, 37-42).

An investigation of neighborhood social factors and their relationship to stress can help bring forth a better understanding of the relationship between external social factors such as neighborhood characteristics and levels of stress for certain populations. Knowledge about particular neighborhood factors' influence on health and explanations of these social interactions with stress is limited. Further investigation is needed to understand the particular types of neighborhood factors, which may cause the most stress, with the goal of trying to intervene and possibly build upon neighborhood strengths.

Measurements of institutional forms of racism such residential redlining are neighborhood, contextual stressors that may be important in understanding social factors related to health beyond an individual's ability to self-report everyday experiences of life stressors. Residential redlining, the practice of banks and other financial institutions denying

loans to communities based on race, is a neighborhood construct that captures a form of institutional racism. Institutional racism refers to the policies, norms and institutions that sustain racial divisions and inequality (11, 65). This can be the product of both overt and covert actions, resulting in a separation of racial groups, disinvestment in racially mixed or non-white communities, and directing investment and resources into homogenous, all-white communities (65). Institutional racism, measured on a neighborhood or community level, could capture a woman's experience that may not be reported in survey data. Understanding residential redlining and segregation is important because it influences proximity to important resources, including institutions such as schools, hospitals, child care facilities and labor markets (75). Access to these resources influences the health of populations.

Although previous studies have investigated the relationship between life stressors such as perceived discrimination and health, studies investigated the relationship between institutional racism and other psychosocial factors are sparse. Additionally, there are no known studies that have investigated residential redlining as a form of institutional racism in relation to perceived stressors and perceptions of neighborhood quality. To address the gaps in the literature, the goals of this paper are to: (1) examine the racial/ethnic differences in residential redlining and segregation, perceived discrimination, stress, and neighborhood quality factors; (2) examine whether residential redlining is associated with perceptions of discrimination, stress, and neighborhood quality; (3) examine the relationship between perceived discrimination and perceived stress; and (4) examine the relationship between perceived neighborhood quality and perceived stress. We hypothesized that black women followed by Latinas are more likely to live in redlined and segregated communities, report

discrimination, report stress and low neighborhood quality compared to white women. We also hypothesized that women who are more likely to report experiences of discrimination, overall stress and low neighborhood quality will be more likely to live in redlined neighborhoods compared to women who do not report these experiences. Finally, women who report experiences of discrimination and low neighborhood quality will be more likely to report higher levels of stress.

METHODS

Data Sources

This study links data from the Stress Pregnancy and Evaluation Community Project (SPEAC), Pennsylvania vital birth records, the Home Mortgage Disclosure Act (HMDA) database and the US Census. The SPEAC survey was from 1999-2004 by the Department of Obstetrics and Gynecology at Jefferson Medical College, Thomas Jefferson University to investigate the relationship between chronic maternal stress and bacterial vaginosis (BV) for pregnant women enrolled at the time of their first prenatal clinic visit. The women received prenatal care from one of eight Philadelphia District Health Centers and two hospital-based clinics. Inclusion criteria for the SPEAC study were singleton gestation, intrauterine pregnancy, and English or Spanish speaking (25). All women regardless of foreign born status will be included in the initial analysis. The average gestational age at the time of BV screening and stress assessment was 14.8 weeks (26). This SPEAC survey includes information about the women's individual health, reports of stress and discrimination, demographic information, the census tracts in which they lived when the survey was collected, and the linked vital birth records. A total of 4880 pregnant women completed the SPEAC survey. Women who had miscarriages, still births or abortions would not have a

birth certificate. As a result, survey information for 4130 (85%) SPEAC participants were successfully matched with the birth file. Out of those women, 3949 (81% of the 4880) had linked birth records and geocoded addresses and are included in the final analysis for this study.

The Home Mortgage Disclosure Act (HMDA) is an administrative database created by the Federal Reserve Board that collects yearly information from banks and other lending institutions providing mortgage loans. The residential redlining construct is derived from the HMDA for years 1999-2004. This dataset contains all loan dealings from financial institutions throughout the United State for a particular year and includes information about type and amount of loan, census tract of the property, loan disposition and characteristics of the applicant. This study excludes (1) incomplete applications that were not processed by lending institutions and therefore could not be part of a measure for loan disposition bias; (2) properties that are not owner-occupied (3) home improvement loans; and (4) multi-family units (12). The analysis for this study only includes mortgage loans with information about the applicant's race and only those identified as black or white race. An index of residential redlining was created for each census tract in Philadelphia County and later linked with the census tracts in which the women lived who completed the Stress Pregnancy and Evaluation Community Project (SPEAC) survey. An average of 16,527 loans per year were included in the HMDA database between 1999-2004 in the analytic sample in Philadelphia County.

The third data source is the year 2000 US Census. The US Census was used to derive a measure for residential segregation based on the index of dissimilarity and to determine the percentage Black for each neighborhood in which the women in SPEAC lived.

Neighborhood Definition

The smallest neighborhood unit included in the HMDA database is the census tract. As a result, the definition of neighborhood for this study will be the census tracts within Philadelphia County. The addresses of women who participated in SPEAC were geocoded and assigned a census tract based on the US 2000 census boundaries.

Measures

Community Level Measures

Residential Redlining. Redlining is derived from the HMDA. The redlining measure is operationalized as black-white loan disposition and hence includes those who identified themselves as black or white. Loans that were missing information about the applicant's race were not included in the analysis. The *race* of the loan applicant will be the main predictor of loan disposition in this study. *Loan action taken*, (accepted/denied), describes whether or not a loan was denied by a financial institution, will be used to create the redlining measure. The redlining measures were created for each year for all relevant census tracts for Philadelphia County. The redlining measures for the census tracts in Philadelphia County were compared across years to see if there were any significant mean changes in redlining between 1999 and 2004. A correlation matrix was used to compare the Bayes estimates of the random effects models for redlining in Philadelphia County over the six year period. Since there were temporal changes in redlining over the six year period, each participant in SPEAC will be given an index of redlining based on the census tract in which she lived and the year that she participated in the study. The redlining index scores ranged from 0.31 to 6.82 with a mean score of 1.95 and a median score of 1.88. A score of 2.0 is interpreted as a neighborhood where the odds of loan denial among blacks are twice the odds of loan denial

among whites. Additional details for creating the redlining measures are described in Chapter 4.

Residential Segregation. The *Index of Dissimilarity* is a measure of residential segregation that quantifies the proportion of Blacks that would have to change their area of residence to achieve an even distribution of the population in census tracts. This index measures the level of evenness or differential distribution of groups across areal units (84). This index ranges from 0 to 1 and is a continuous measure stemming from the US Census and linked to the geocoded addresses of the women from the Stress Pregnancy and Evaluation Community Project (SPEAC). Calculations for the index of dissimilarity are described in Chapter 4.

Individual Measures

Perceived Discrimination. SPEAC participants were asked about *perceived discrimination* based on everyday experiences of discrimination and major experiences of discrimination. Respondents were asked to rate the frequency of day to day experiences of discrimination because of "race, ethnicity, income level, social class, sex, gender, age sexual orientation, physical appearance or religion" (82). These experiences were rated on a six-point scale ranging from "never" to "almost every day." The total score was summed and analyses were conducted to determine the distribution of the scores and appropriate categorizations of the measure. The scores ranged from 0 to 43. The summed score was then categorized by level of discrimination: none (0 points), low (1-10 points), medium (11-20 points), high (21+ points). This was referred to as the *everyday discrimination* measure. These cutpoints were based on the cluster of individuals that had a score of zero and approximate intervals of 10 for the remaining categories. A sensitivity analysis was also

conducted to examine if mean redlining scores varied based on choice of categorizations for the perceived discrimination score (results not shown). The continuous form of this scale and the categorized form was evaluated in this study. Respondents were also asked to answer "yes" or "no" to two questions about major experiences of discrimination. Those questions were: 1) "For unfair reasons, do you think that you have ever not been hired for a job?" and 2) "Have you ever been unfairly stopped, searched, questioned, physically threatened or abused by police?" These two questions were added together, resulting in 0, 1 or 2 major events. This was referred to as the major discrimination measure.

Perceived Stress. SPEAC participants were asked to complete a 14-item self-report Cohen Perceived Stress Scale (CPSS), which measures the degree to which a respondent appraises stressful circumstances along dimensions of unpredictability, uncontrollability and overload (83, 129). Examples of questions included in this scale are, "You have felt that you were unable to control the important things in your life," "You have felt nervous or 'stressed'" and "You have felt that you were on top of things." Participants answers are based on a Likert scale to what degree the item relates to them in the past month (0=never, 1=almost never, 2=sometimes, 3=fairly often or 4=very often). A total CPSS is computed by summing across all items. The scores ranged from 0 to 51. This scale is suggested for examining the role of appraised stress in the etiology of disease (83). The CPSS has good internal reliability and fair test-retest reliability among college and community samples (83). The continuous form of this scale was analyzed as well as a categorized form of the scale. The categorized form of the scale was derived by summing across the questions and then dividing the summed score by the total number of answered questions. These scores were

then categorized as 0, 1, 2, 3 or 4 based on the Likert scale. The final scores of 0-4 were also analyzed.

Perceived Neighborhood Quality. The SPEAC respondents answered specific questions about the quality of neighborhoods. The neighborhood quality scale was derived from Coulton, Korbin and Su's work on perceptions of neighborhoods in urban areas (126, 130). The scale included three core domains: crime and safety, physical disorder, and social disorder (126, 130). The SPEAC participants were asked, "Please tell me how often these things are a problem or are found in your neighborhood." Examples of neighborhood factors were little or trash on the sidewalks, vacant buildings and gunshots in the neighborhood. Respondents rated the neighborhood quality factors on a 10-point scale where 1 was rarely/not worried and 10 was frequently/very worried. A sum score was created for the 19 neighborhood quality factors for a range of scores of 1 to 190.

Covariates included in this analysis were based on theoretical and conceptual models and were found to be related to neighborhood contextual factors as well as perceived stress, discrimination and neighborhood quality in previous studies (12, 54, 101, 118, 120, 121, 126). Control of all of the following covariates, regardless of statistical significance or percent changes in estimates, were ultimately applied since model convergence was not compromised (131). Maternal Race/Ethnicity. SPEAC participants were asked to identify their race, which also included an option of Hispanic ethnicity. The classifications included in this study are non-Hispanic white, non-Hispanic black, Hispanic/Latina, Other. We also included age at interview as continuous variable that was grand mean centered for the analysis. Total household income was operationalized as income from jobs, public assistance, unemployment, SSI, from family/friends or other sources. This was a categorical variable

where respondents chose an income range that best fit their circumstances. Education was categorized as less than high school, high school/GED or post-high school. Marital status was categorized as married/living as married or not married/not living as married.

Statistical Analyses

Residential Redlining Measure. The final redlining measure was calculated by using a multilevel logistic model. Multilevel logistic models were run to create Empirical Bayes' estimates for each census tract for the black-white difference in denial of loans after adjusting for all other covariates. Model specification and further details about the construction of the redlining index are included in Chapter 4. The GLIMMIX Procedure in SAS 9.2 was used to conduct these analyses.

Additional Analyses. Response frequencies and means were examined for residential redlining, the various perception scales and other respondent characteristics. Bivariate analyses were conducted to examine the association between redlining and perceived discrimination, redlining and perceived stress, redlining and perceived neighborhood quality, and perceived discrimination and perceived stress. Bivariate analyses were conducted to examine the relationship between perception scales and race/ethnicity and other demographic factors.

We analyzed the data using various functional forms (i.e. linear regression and cumulative logit), and both approaches yielded similar results. Linear regression models were conducted to determine the relationship between residential redlining and the three perception scales: perceived discrimination, perceived stress and perceived neighborhood quality after adjusting for covariates. Proportional odds models were utilized simultaneously to compare modeling strategies and estimates with the linear models used (132, 133). In

cases where the proportional odds assumption was violated, we fit a partial proportional odds model instead (87). The results from the multivariate linear regression model are included in the following tables, and the alternative proportional odds models are included in Appendix B for further reference. SAS version 9.2 was used to complete all analyses.

RESULTS

Descriptive Results

Characteristics of the women in this analysis are included in Table 5.1. The majority of the population were non-Hispanic Black (67%) followed by Hispanic (20%) women. The mean age for the entire population was 24 years old. Approximately 20 percent of the women in the entire population made less than $5000 per year. Approximately 43 percent of the entire population had a high school education and 24 percent were married with significant variation by racial/ethnic group for these characteristics. The majority of the participants did not smoke or use alcohol although white women were more likely to use alcohol than women from any other racial/ethnic group. The mean scores for the perceptions scales are included in Table 5.1. The mean index for residential redlining among the entire population is 1.9, indicating that participants in the SPEAC study live in neighborhoods where blacks are 1.9 times as likely as white to be denied a mortgage loan. The mean index of dissimilarity, measuring residential segregation was 0.4 for the SPEAC population, which is significantly smaller than the indices reported for the population of Philadelphia (68).

Bivariate Results

The first objective of this study was to examine the racial/ethnic differences in residential redlining and segregation, perceived discrimination, stress, and neighborhood quality (Table 5.1). First, we hypothesized that non-Hispanic black women would be more

likely to live in redlined and segregated areas, report discrimination, stress and poor neighborhood quality. Black non-Hispanic women had a greater mean residential redlining index (2.0) and perceived everyday discrimination score (5.3) compared to women of all other racial/ethnic groups. However, non-Hispanic white women were most likely to live in segregated neighborhoods with an index score of 0.49. The mean perceived stress score was highest among Hispanic women (24.3) followed by white non-Hispanic women (23.8) then black non-Hispanic women (22.5). Black non-Hispanic women had worse ratings of their neighborhoods with a higher mean neighborhood quality score (73.7) compared to women of all other racial/ethnic groups.

Table 5.2 presents selected study sample characteristics by perceptions of discrimination, stress and neighborhood quality. There seems to be an increase in mean perceived everyday discrimination, stress and neighborhood quality scores as the income level decreases among the population. The mean perceived everyday discrimination, stress and neighborhood quality scores also increased as educational level decreases. The mean perceived everyday discrimination and stress scores are slightly higher among non-married women compared to married women, and there is a ten point difference in mean perceived neighborhood quality score between married and non-married women.

The second objective of this study was to examine the association between residential redlining and perceptions of stress, discrimination and neighborhood quality. Residential redlining was not associated with perceived everyday discrimination, major discrimination, or perceived stress, but it was positively associated with worse perceived neighborhood quality (Table 5.2). Residential redlining is moderately associated with percent black on the census tract level and residential segregation as measured by black dissimilarity with

correlation coefficients of 0.155 and 0.248 respectively (Table 5.3). Our third and fourth objectives were to measure the association between perceived discrimination and perceived stress as well as perceived neighborhood quality and perceived stress. We find that perceived stress is moderately associated with perceived discrimination and perceived neighborhood quality with correlation coefficients of 0.190 and 0.124 respectively (Table 5.3).

Multivariate Results

With further analysis through multivariate models for the entire population and stratified by race, we examined the associations between redlining and the perceptions of discrimination, stress and neighborhood quality (Table 5.4). Based on the analyses for all women, we find that residential redlining is not associated with perceived stress or perceived discrimination. However, we found residential redlining was associated with perceived poor neighborhood quality ($b= 2.4$, $p<0.01$). Being married, having more education, and increased income were associated with decreased perceived stress. Higher levels of income were associated with less perceptions of perceived discrimination. Having a high school education versus a post-high school education was associated with less perceptions of stress ($b= -0.99$, $p<0.01$). When examining racial/ethnic differences, non-Hispanic Black women were less likely to perceive stress compared to non-Hispanic white women ($b= -1.46$, $p<0.01$). Non-Hispanic Black women were more likely to perceive discrimination compared to non-Hispanic white women ($b= 1.38$, $p<0.01$). Non-Hispanic black women were more likely to perceive poor neighborhood quality compared to non-Hispanic white women ($b= 17.57$, $p<0.01$). Hispanic women were also more likely to perceive poor neighborhood quality compared to non-Hispanic white women ($b=10.09$, $p<0.01$).

Among non-Hispanic Black women only, we find that an increase in residential redlining is not associated with perceived stress and discrimination but it is significantly associated with perceived poor neighborhood quality ($b=2.26$, $p<0.01$). Women who were married, more educated and of higher incomes were less likely to perceive stress. Having more income and education was associated with increases in perceived discrimination. Decreased age, more education and more income was associated with perceived poor neighborhood quality.

Among non-Hispanic white women only, we find that an increase in residential redlining is significantly associated with a decrease in perceived discrimination ($b= -1.16$, $p<0.01$) and a decrease in perceived poor neighborhood quality ($b= -7.23$, $p<0.01$). This indicates that residential redlining results in better neighborhood ratings among non-Hispanic white women. Residential redlining is not associated with perceived stress. Increased age and increased income are associated with an increase in perceived discrimination. Non-Hispanic white women who are married and more highly educated are less likely to perceive stress.

Among Latinas/Hispanic women, increased redlining is not associated with perceived stress or perceived discrimination but is associated with perceived poor neighborhood quality ($b= 8.26$, $p<0.01$). Among this population, less education was associated with an increase in perceived stress and increased income was associated with a decrease in perceived poor neighborhood quality. Stratified analyses for women in the 'other' racial category were not conducted because of small numbers.

The linear fixed effects models and coefficients presented in Table 5.4 were duplicated using proportional odds models or cumulative logit models. The tables for these

analyses are included in Appendix B. The results are quite similar in that residential redlining is not associated with perceived stress or discrimination among all women. Residential redlining was associated with perceived poor neighborhood quality (OR=1.13, 95% CI: 1.04, 1.22). Among non-Hispanic black women, the results are similar to the linear model where residential redlining was not associated with perceived stress or discrimination but was associated with perceived poor neighborhood quality. Among non-Hispanic white women, redlining was associated with perceived discrimination and neighborhood quality, similar to the linear model. Finally, among Latinas/Hispanic women, redlining was associated with perceived neighborhood quality.

DISCUSSION

This study examines whether three perception scales: discrimination, stress and neighborhood quality were associated with residential redlining, a measure of institutional racism among a cohort of pregnant women. This is the first study of its kind to examine maternal psychosocial factors in association with residential redlining. Previous studies examining psychosocial factors among pregnant populations have reviewed individual perceptions while this study adds to this body of literature by also examining its relationship with contextual factors (20, 36, 44, 46, 54, 56, 59, 94, 126-128).

We first examined whether there were racial/ethnic differences in residential redlining, perceived stress, neighborhood quality or discrimination. Black non-Hispanic women followed by women in the 'Other' racial category then Latinas were more likely to report discrimination scores compared to non-Hispanic white women. This was similar to our hypothesis except that we expected for Latinas to report more experiences of everyday discrimination than women in the 'Other' racial category. Latinas were more likely to report

experiences of stress compared to women of other racial/ethnic groups. This trend was not as expected. We expected non-Hispanic black women to be more likely to report stress due to the notion that these women also experience more external stressors compared to their non-Black counterparts. It is plausible that the Hispanic women and non-Hispanic white women in this study are more likely than non-Hispanic black women to appraise their stress as measured by the CPSS or this stress scale may not be as valid among this particular population. This scale has been initially tested and implemented among white males and college populations (83). There may be variation in how the questions in this CPSS as well as the other two scales implemented in this study are interpreted across racial/ethnic groups. It is also plausible that the Hispanic women in the study, who are predominantly of Puerto Rican descent (almost 60 percent), actually experience more stress than the women of other racial/ethnic groups. Among Hispanic subgroups, Puerto Rican women have the highest preterm birth rates, suggesting a social experience unique to this population (134). Research also suggests that historically Puerto Ricans experienced a high degree of segregation and discrimination in housing, resulting in poverty and community deprivation (74). This social experience is attributed to the fact that a large proportion of Puerto Ricans are of African descent (74).

We examined the effect of institutional racism in the form of residential redlining on women's perceptions of discrimination, stress and neighborhood quality. We hypothesized that redlining exposure would result in increased reporting of stress, discrimination and poor neighborhood quality. We found that residential redlining was independently related to perceptions of poor neighborhood quality for all women and for each racial/ethnic group separately. Since redlining captures a neighborhood construct that indicates a level of racism

or adverse institutional practices on the community level, it is plausible that this population perceives poorer neighborhood quality in redlined neighborhoods. This finding was expected and is supported in other studies that examine the relationships between objective measures of neighborhoods and perceptions of neighborhoods (40, 126, 135). However, among all women in the study, perceived discrimination and perceived stress were not related to residential redlining. These findings were similar among non-Hispanic black women and Hispanic women. This lack of association could be because residential redlining is measuring a completely different construct than perceived discrimination. Another explanation is the measures of perceived discrimination and perceived stress implemented in this study may not truly capture the experiences of minority women.

On the other hand, among non-Hispanic white women, an increase in residential redlining resulted in the women being less likely to report discrimination. This finding was opposite of what was expected. One possible explanation for this finding is that redlined neighborhoods actually benefit non-Hispanic white women. Additionally, there may be other mediating factors in the pathways between residential redlining and the perception measures, and this may vary by racial/ethnic groups. Future studies could incorporate other mediating factors in these relationships. Another explanation is that non-Hispanic white women may be more likely to appraise stress and discrimination as measured by these scales compared to non-Hispanic black women and Hispanic women. The population of women in the SPEAC study, particularly the non-Hispanic white women, is quite unique compared to other pregnant women in Philadelphia and nationally. For example, births to unmarried women in Philadelphia in 2001 to 2002 for non-Hispanic blacks, non-Hispanic whites and Hispanics was 74.3, 19.5 and 61.2 percent respectively (136). Among the SPEAC population, this was

83.5, 74.7, 55.8 respectively. Smoking during pregnancy for women in Philadelphia in 2001 to 2002 for non-Hispanic blacks, non-Hispanic whites and Hispanics was 11.7, 12.6 and 9.9 percent respectively (136). Among the SPEAC population, this was 20.2, 50.7, and 13.6 respectively. Compared to data of vital birth records of women in Philadelphia who gave birth in 2001, the women in SPEAC were younger, more likely to be non-Hispanic black, less educated, and less likely to be married (126).

We also examined the relationship between perceived discrimination and perceived stress as well as perceived neighborhood quality and perceived stress. As hypothesized, there was a positive association between perceived stress and perceived discrimination and neighborhood quality. It is possible that pregnant women who provide low ratings for their neighborhoods and are more likely to report discrimination are also more likely to experience higher levels of perceived stress. The direction of this association is difficult to establish or discern in a cross-sectional study, but future studies could examine the direction of this association and possible mediators in these relationships.

There were some limitations to this study. Since the SPEAC cohort is a clinic-based sample, pregnant women may be excluded who do not seek prenatal care or have access to prenatal care. To address this issue, SPEAC participants were recruited from both public and private clinics for a range of socioeconomic backgrounds. However, the overall population characteristics may limit whether this study can be generalized to other populations. The perceptions scales used in this study may not be valid among this population. The CPSS was initially validated among predominantly college samples but then also applied among other populations (83). The perceived discrimination scale is a conglomerate of previous discrimination scales, but the one utilized in this study is non-specific in that it captures

discrimination based on several social markers, not just racial discrimination. This lack of specificity makes it difficult to detect if the respondent has been primarily discriminated against because of their race, gender, sexual orientation or some other social marker.

Despite some of the limitations, this study provides an objective, community-level measure of racism, which could serve as a proxy for psychosocial stress and the overall experiences of women during pregnancy. The measure for redlining employed in this study may capture an experience that is not necessarily appraised or reported by individual pregnant women, but may have an influence on their pregnancies and subsequent birth and health outcomes. This study suggests that redlining is a strong predictor of perceived poor neighborhood quality, stress and discrimination for specific racial/ethnic subgroups. Future studies examining birth outcomes, the health of pregnant women and overall health disparities related to these outcomes, may find that examining an objective measure such as redlining provides additional insight into the relationships between external stressors such neighborhood context and perceived stress.

TABLES

Table 5.1: Selected Characteristics of the SPEAC Population by Race/Ethnicity, 1999-2004

		Race/Ethnicity			
Characteristic	**Total**	**Black (non-Hispanic)**	**White (non-Hispanic)**	**Latina/ Hispanic**	**Other**
Race/Ethnicity, N (%)	3949	2661 (67.44)	364 (9.22)	803 (20.35)	118 (2.99)
Age, mean (SD)	24 (5.7)	24 (5.8)	24 (5.3)	24 (5.2)	25 (6.3)
Total Household Income, N (%)					
Under $5,000	718 (20.28)	389 (16.28)	34 (11.33)	276 (36.85)	18 (18.18)***
$5,000-9,999	526 (14.86)	347 (14.52)	29 (9.67)	136 (18.16)	14 (14.14)
$10,000-14,999	470 (13.28)	323 (13.51)	40 (13.33)	86 (11.48)	21 (21.21)
$15,000-19,999	444 (12.54)	300 (12.55)	44 (14.67)	88 (11.75)	12 (12.12)
$20,000-24,999	413 (11.67)	306 (12.80)	43 (14.33)	50 (6.68)	14 (14.14)
$25,000-29,999	292 (8.25)	219 (9.16)	22 (7.33)	43 (5.74)	8 (8.08)
$30,000-34,999	246 (6.95)	184 (7.70)	22 (7.33)	34 (4.54)	6 (6.06)
$35,000-39,000	148 (4.18)	116 (4.85)	16 (5.33)	14 (1.87)	1 (1.01)
$40,000+	283 (7.99)	206 (8.62)	50 (16.67)	22 (2.94)	5 (5.05)
Education, N (%)					
Less than HS	1516 (38.45)	922 (34.67)	151 (41.48)	403 (50.25)	40 (33.90)***
HS Grad/GED	1711 (43.39)	1239 (46.60)	158 (43.41)	270 (33.67)	44 (37.29)
Post-HS	716 (18.16)	498 (18.73)	55 (15.11)	129 (16.08)	34 (28.81)
Marital Status, N (%)					
Married/Cohabiting	946 (23.97)	440 (16.54)	92 (25.27)	355 (44.21)	59 (50)***
Not Married	3000 (76.03)	2221 (83.46)	272 (74.73)	448 (55.79)	59 (50)
Tobacco Use During Pregnancy, N (%)					
No	3093 (78.58)	2116 (79.76)	179 (49.31)	694 (86.43)	104 (88.89)***
Yes	843 (21.42)	537 (20.24)	184 (50.69)	109 (13.57)	13 (11.11)

		Race/Ethnicity			
Characteristic	**Total**	**Black (non-Hispanic)**	**White (non-Hispanic)**	**Latina/ Hispanic**	**Other**
Recent Alcohol Use, N (%)					
No	2560 (64.97)	1727 (65.02)	157 (43.13)	583 (72.69)	93 (78.81)***
Yes	1380 (35.03)	929 (34.98)	207 (56.87)	219 (27.31)	25 (21.19)
Parity, N (%)					
None	1559 (41.76)	1055 (41.49)	172 (49.0)	274 (37.90)	58 (50.0)***
One	1071 (28.69)	699 (27.49)	103 (29.34)	239 (33.06)	30 (25.86)
Two or More	1103 (29.55)	789 (31.03)	76 (21.65)	210 (29.05)	28 (24.14)
Residential Redlining, M (SD)	1.949 (0.75)	2.00 (0.75)	1.92 (0.85)	1.83 (0.69)	1.88 (0.74)***
Residential Segregation (Index of Dissimilarity), M (SD)	0.40 (0.13)	0.40 (0.12)	0.49 (0.17)	0.35 (0.12)	0.42 (0.15)***
Residential Segregation (Exposure Index), M (SD)	0.17 (0.24)	0.11 (0.17)	0.53 (0.25)	0.22 (0.24)	0.31 (0.28)***
Residential Segregation (Isolation Index), M (SD)	0.64 (0.32)	0.79 (0.26)	0.27 (0.22)	0.35 (0.22)	0.49 (0.31)***
Perceived Discrimination (Everyday Discrimination), M (SD)	5.02 (7.01)	5.26 (7.15)	3.74 (6.17)	4.70 (6.80)	5.19 (6.43)***
Perceived Discrimination (Major Discrimination), N (%)					
No Events	3238 (82.31)	2162 (81.49)	312 (86.19)	658 (82.25)	104 (88.89)*
One Event	600 (15.25)	414 (15.60)	42 (11.60)	132 (16.50)	12 (10.26)
Two Events	96 (2.44)	77 (2.90)	8 (2.21)	10 (1.25)	1 (0.85)
Perceived Stress, M (SD)	23.03 (7.64)	22.52 (7.94)	23.78 (7.65)	24.27 (6.47)	22.23 (7.73)***
Number Years in Neighborhood, M (SD)	6.92 (8.17)	8.08 (8.65)	7.33 (8.09)	3.24 (5.19)	4.14 (5.17)***
Neighborhood Quality, M (SD)	70.17 (41.28)	73.69 (41.50)	53.32 (35.50)	68.40 (41.62)	54.42 (33.49)***

***p<0.05; **p<0.01; ***p<0.001**

Table 5.2: Selected Characteristics of the SPEAC Population by Perceived Discrimination, Stress and Neighborhood Quality, 1999-2004

Characteristics	Perceived Discrimination				Cohen Perceived Stress Scale M (SD)	Neighbor-hood Quality M (SD)
	Everyday Discrim, M (SD)	Major Discrimination, N (%)				
		No Events	One Event	Two Events		
Race/Ethnicity						
Black (non-Hispanic)	5.26 (7.15)***	2162 (81.49)	414 (15.60)	77 (2.90)*	22.52 (7.95)***	73.69 (41.50)***
White (non-Hispanic)	3.74 (6.17)	312 (86.19)	42 (11.60)	8 (2.21)	23.78 (7.65)	53.32 (35.50)
Latina/Hispanic	4.70 (6.80)	658 (82.25)	132 (16.50)	10 (1.25)	24.27 (6.47)	68.40 (41.62)
Other	5.19 (6.43)	104 (88.89)	12 (10.26)	1 (0.85)	22.23 (7.73)	54.42 (33.49)
Total Household Income						
Under $5,000	5.65 (7.88)***	567 (79.30)	131 (18.32)	17 (2.38)	24.35 (7.04)***	80.26 (42.49)***
$5,000-9,999	4.86 (6.73)	428 (81.52)	82 (15.62)	15 (2.86)	23.58 (7.50)	76.31 (41.36)
$10,000-14,999	5.37 (7.21)	404 (86.32)	55 (11.75)	9 (1.92)	22.35 (7.59)	72.61 (41.23)
$15,000-19,999	4.71 (6.47)	359 (81.04)	73 (16.48)	11 (2.48)	21.82 (8.01)	65.68 (40.68)
$20,000-24,999	4.67 (6.41)	331 (80.93)	67 (16.38)	11 (2.69)	22.41 (7.88)	66.07 (38.60)
$25,000-29,999	4.25 (6.79)	247 (84.59)	38 (13.01)	7 (2.40)	22.60 (8.17)	66.98 (42.23)
$30,000-34,999	3.88 (5.87)	213 (86.59)	26 (10.57)	7 (2.85)	20.99 (7.86)	62.79 (40.13)
$35,000-39,000	4.01 (6.51)	123 (83.67)	19 (12.93)	5 (3.40)	21.45 (7.44)	67.58 (39.85)
$40,000+	3.66 (5.59)	242 (85.51)	36 (12.72)	5 (1.77)	22.41 (7.96)	58.64 (37.53)
Education						
No HS	5.57 (7.62)***	1245 (82.45)	228 (15.10)	37 (2.45)	23.99 (7.28) ***	76.78 (42.13) ***
HS Grad/GED	4.51 (6.44)	1405 (82.26)	262 (15.34)	41 (2.40)	22.76 (7.80)	68.57 (40.64)
Post-HS	5.02 (6.74)	584 (82.02)	110 (15.45)	18 (2.53)	21.40 (7.85)	59.82 (38.48)
Marital Status						
Married/Cohabiting	4.57 (6.44)	773 (82.67)	142 (15.19)	20 (2.14)	22.22 (7.75)***	62.70 (38.82)***

Characteristics	Perceived Discrimination				Cohen Perceived Stress Scale M (SD)	Neighbor-hood Quality M (SD)
	Everyday Discrim, M (SD)	Major Discrimination, N (%)				
		No Events	One Event	Two Events		
Not Married/Living as Married	5.14 (7.14)	2465 (82.19)	458 (15.27)	76 (2.53)	23.23 (7.63)	72.51 (41.76)
Residential Segregation (Index of Dissimilarity), M SD	--	0.40 (0.14)	0.40 (0.13)	0.40 (0.14)	--	--
Residential Segregation (Exposure Index), M SD	--	0.18 (0.24)	0.16 (0.23)	0.15 (0.22)	--	--
Residential Segregation (Isolation Index), M SD	--	0.63 (0.32)	0.65 (0.32)	0.68 (0.32)	--	--
Residential Redlining, M (SD)	--	1.95 (0.75)	1.91 (0.72)	2.06 (0.79)	--	--
Residential Redlining						
Redlined	4.98 (7.02)	2491 (82.57)	453 (15.01)	73 (2.42)	22.93 (7.74)	71.42 (41.53)***
Other	5.14 (6.95)	712 (81.75)	137 (15.73)	22 (2.53)	23.38 (7.24)	65.01 (40.05)

***p<0.05; **p<0.01; ***p<0.001**

Table 5.3: Pearson Correlation Coefficients of Residential Redlining, Other Community Level Factors and Perception Scales, 1999-2004

	Residential Redlining	NH-Black Dissimilarity	NH-Black Exposure	NH-Black Isolation
Residential Redlining	1			
NH-Black Dissimilarity Index	0.248***	1		
NH-Black Exposure Index	-0.115***	0.178***	1	
NH-Black Isolation Indx	0.174***	0.0753***	-0.776***	1
Percent Black	0.155***	-0.0188	-0.766***	0.986***
Perceived Everyday Discrimination	0.00688	-0.00173	-0.0855***	0.0842***
Perceived Major Discrimination	-0.00107	-0.01812	-0.0343*	0.0312
Perceived Stress	0.0117	-0.0150	0.0231	-0.0664***
Perceived Neighborhood Quality	0.0414*	0.0442**	-0.352***	0.259***

	Percent Black	Perceived Everyday Discrim.	Perceived Major Discrim.	Perceived Stress	Perceived N-hood Quality
Percent Black	1				
Perceived Everyday Discrimination	0.0824***	1			
Perceived Major Discrimination	0.03378	0.315***	1		
Perceived Stress	-0.0690***	0.190***	0.124***	1	
Perceived Neighborhood Quality	0.258***	0.230***	0.106***	0.124***	1

***p<0.05; **p<0.01; ***p<0.001**

Table 5.4: Coefficients from fixed-effects linear models predicting perceptions of discrimination, stress and neighborhood quality for all women and stratified by racial/ethnic group, 1999-2004[++]

	All Women		
	PS[+]	**PD**[+]	**NQ**[+]
Intercept	22.77 (0.95)**	6.024 (0.856)**	70.240 (4.986)**
Residential Redlining	0.29 (0.17)	-0.0214 (0.157)	2.405 (0.916)**
Age	0.032 (0.024)	-0.0335 (0.0214)	-0.632 (0.125)**
Marital Status (not married)			
Married/Cohabiting	-1.13 (0.32)**	-0.0043 (0.2875)	-3.329 (1.674)*
Education (Post-HS)			
No HS	1.76 (0.39)**	-0.241 (0.351)	11.282 (2.045)**
HS Grad/GED	1.17 (0.36)**	-0.993 (0.325)**	5.045 (1.897)**
Total Household Income (Under $5000)			
$5,000-9,999	-0.54 (0.44)	-0.811 (0.399)*	-4.866 (2.321)*
$10,000-14,999	-1.62 (0.46)**	-0.258 (0.417)	-6.018 (2.429)*
$15,000-19,999	-2.13 (0.47)**	-0.894 (0.424)*	-13.017 (2.470)**
$20,000-24,999	-1.38 (0.48)**	-1.034 (0.438)*	-13.00 (2.549)**
$25,000-29,999	-1.16 (0.54)*	-1.458 (0.488)**	-11.943 (2.843)**
$30,000-34,999	-2.72 (0.58)**	-1.945 (0.521)**	-16.023 (3.034)**
$35,000-39,000	-2.21 (0.70)**	-1.709 (0.636)**	-11.549 (3.705)**
$40,000+	-1.19 (0.56)*	-2.095 (0.503)**	-18.416 (2.934)**
Race/Ethnicity (White NH)			
Black NH	-1.46 (0.47)**	1.380 (0.424)**	17.565 (2.473)**
Latina/Hispanic	0.183 (0.54)	0.430 (0.484)	10.089 (2.817)**
Other	-1.10 (0.89)	1.522 (0.799)	0.799 (4.659)

	Black Women Only			**White Women Only**			**Latinas Only**		
	PS[+]	**PD**[+]	**NQ**[+]	**PS**[+]	**PD**[+]	**NQ**[+]	**PS**[+]	**PD**[+]	**NQ**[+]
Intercept	21.556 (1.051)**	7.11 (0.92)**	88.58 (5.32)**	22.42 (3.05)**	13.21 (2.28)**	84.22 (13.80)**	21.99 (1.58)**	6.30 (1.70)**	68.10 (10.23)**
Residential Redlining	0.401 (0.219)	0.13 (0.19)	2.26 (1.11)*	-0.40 (0.57)	-1.16 (0.43)**	-7.23 (2.59)**	0.51 (0.34)	0.055 (0.37)	8.26 (2.21)**
Age	0.0373 (0.0294)	-0.018 (0.026)	-0.67 (0.15)**	0.018 (0.085)	-0.15 (0.063)*	-0.28 (0.38)	0.035 (0.046)	-0.047 (0.050)	-0.45 (0.30)
Marital Status (not married)									
Married/Cohabiting	-1.190 (0.453)**	0.49 (0.40)	-3.16 (2.30)	-2.70 (1.04)**	-0.63 (0.78)	-5.45 (4.71)	-0.64 (0.47)	-0.81 (0.51)	-2.59 (3.05)
Education (Post-HS)									
No HS	1.579 (0.498)**	-0.29 (0.44)	15.11 (2.52)**	2.34 (1.32)**	-1.55 (1.04)	-3.32 (6.31)	1.44 (0.71)*	0.092 (0.76)	4.79 (4.60)
HS Grad/GED	1.082 (0.450)*	-1.50 (0.40)**	6.41 (2.28)**	3.69 (1.38)	0.26 (0.99)	-4.96 (6.03)	0.83 (0.71)	-0.37 (0.76)	3.89 (4.63)
Total Household Income (Under $5000)									
$5,000-9,999	-1.199 (0.591)*	-0.66 (0.52)	-6.11 (2.99)*	0.58 (2.0)	-4.36 (1.48)**	-12.63 (8.96)	0.24 (0.66)	-0.94 (0.72)	-3.76 (4.31)
$10,000-	-2.405	-0.58	-7.20	-1.10	-1.24 (1.38)	-6.11 (8.36)	0.30	-0.35	-6.18

	Black Women Only			White Women Only			Latinas Only		
	PS+	PD+	NQ+	PS+	PD+	NQ+	PS+	PD+	NQ+
14,999	(0.604)**	(0.53)	(3.06)*	(1.85)			(0.79)	(0.85)	(9.19)
$15,000-19,999	-2.751 (0.616)**	-1.36 (0.54)*	-14.51 (3.12)**	-0.42 (1.83)	-3.88 (1.37)**	-9.49 (8.31)	-1.52 (0.78)	0.37 (0.84)	-12.63 (5.07)*
$20,000-24,999	-1.707 (0.615)**	-1.39 (0.54)*	-15.12 (3.11)**	-0.42 (1.83)	-2.09 (1.37)	6.27 (8.32)	-1.02 (0.97)	-1.02 (1.05)	-18.09 (6.33)**
$25,000-29,999	-1.714 (0.677)*	-1.96 (0.60)**	-14.68 (3.43)**	0.059 (2.17)	-3.85 (1.62)*	-4.58 (9.83)	-0.38 (1.06)	0.069 (1.13)	-5.20 (6.86)
$30,000-34,999	-3.131 (0.722)**	-2.36 (0.63)**	-17.81 (3.65)**	-1.41 (2.15)	-2.81 (1.61)	0.74 (9.75)	-2.14 (1.18)	-1.49 (1.27)	-22.47 (7.69)**
$35,000-39,000	-3.069 (0.853)**	-1.88 (0.75)*	-14.19 (4.32)**	1.64 (2.36)	-5.64 (1.77)**	8.53 (10.72)	-1.97 (1.74)	-1.38 (1.87)	-19.21 (11.33)
$40,000+	-1.743 (0.703)*	-2.27 (0.62)**	-20.62 (3.55)**	-0.17 (1.77)	-5.47 (1.33)**	-12.63 (8.96)	-0.39 (1.41)	0.65 (1.51)	-6.18 (9.19)

+PD=Perceived Discrimination; PS=Perceived Stress; NQ=Neighborhood Quality

++Beta Coefficients and standard errors

***<0.05; **p<0.01**

CHAPTER 6: MANUSCRIPT 3

Residential Redlining, Perceptions of Discrimination, Stress, and Perceived Neighborhood Quality and the Risk of Preterm Birth Among Urban Pregnant Women

Abstract

PURPOSE. This study examined whether institutional racism in the form of residential redlining and perceptions of discrimination, stress and neighborhood quality were associated with preterm birth among a diverse cohort of pregnant women. **METHODS.** We conducted a secondary analysis of a cohort of 3,949 pregnant women from the Stress Pregnancy and Evaluation Community Project (SPEAC). Perceptions of discrimination, stress, and neighborhood quality were measured at the individual level through interviews. An index for residential redlining was constructed using the Home Mortgage Disclosure Act (HMDA) database. Multilevel logistic regression models were conducted to examine whether residential redlining and perceptions of stress, discrimination and neighborhood quality were associated with preterm birth. **RESULTS.** We found a slightly higher mean residential redlining index among term births (1.95) compared to preterm births (1.90), but these differences were not statistically significant. Perceptions of stress, discrimination and neighborhood quality were not associated with preterm birth. **CONCLUSION.** Although residential redlining was not associated with preterm birth among this population, future studies could examine its application in other contexts and in relation to other health outcomes.

INTRODUCTION

Preterm birth is a major determinant of perinatal mortality and neonatal and infant morbidity in the United States, having social, economic and physical effects on infants, families and society (15, 16, 137). Although the highest risk of infant mortality is among very preterm infants (32 weeks gestation), infants born shortly before term (34-36 weeks gestation) are three times as likely to die than term infants (138). Additionally, the preterm birth rate has increased steadily since the 1980's, and black-white disparities in preterm birth have also increased (15, 138, 139). Even with the introduction of technologies and medical interventions, the overall infant mortality rates and preterm birth rates in the US and disparities in perinatal outcomes have not improved substantially (36, 139).

The complex pathophysiology of preterm birth is not well understood and existing interventions and public health programs have not been able to diminish the existing racial and ethnic disparities (36). Eliminating the disparity entails understanding the complex interplay of contributing factors and elucidating the pathways leading to the disparity (36). Studies have attempted to explain disparities in perinatal outcomes by focusing on individual factors such as health behaviors, educational level or use of medical services such as prenatal care (1, 19, 29, 36). Researchers investigating disparities in perinatal health have also explored the social context as fundamental causes of the disparity (4-7).

Adverse external, contextual factors are hypothesized to be stress inducing, contributing to disparities (5, 9, 12, 19, 36, 47, 54-56). These external factors may directly or indirectly influence individual health behaviors, access and use of health services and ultimately physiologic function (36). Many studies have explored the effects of perceived

stress or individual self-reported stressors on perinatal health, yet it is unclear as to what extent these factors contribute to the disparity (7, 34, 36, 46, 47, 55, 56, 59, 128, 140). Measurements of individual psychosocial stressors in these studies include perceived stress, perceived anxiety, depression and perceived racism. Perceived racism is considered a stressor unique to African Americans and other minority populations in the US, affecting health and possibly contributing to existing health disparities (10, 12, 44, 60-62, 92-96, 141-143).

However, reporting of perceptions of racism, not necessarily experiences of racism, may vary because of other factors such as socioeconomic status (44). As a result, examination of other chronic, pervasive stressors that do not rely on individual report are warranted (36). More recently, social epidemiologists and other researchers have explored the social context of health through multilevel studies, evaluating the dual effects of reported individual factors such as perceived racism as well as social, context factors that are external to the individual (12, 33, 114).

Institutional racism, as a social stressor, refers to the major policies, norms and institutions that result in differential access to resources and power based on race (11). Institutional racism has not been adequately studied in epidemiologic research in relation to individual factors such as perceived racism or perceived stress simultaneously in relation to birth outcomes. Previous studies have evaluated residential segregation as a form of institutional racism and as a cornerstone of existing perinatal disparities (38, 68, 75, 100, 101, 144, 145). Residential redlining, also known as systematic housing discrimination by lending institutions on the community level, is thought to contribute to racial residential segregation (74). However, no studies to our knowledge examine residential redlining as a

form of institutional racism among a population of pregnant women to assess an association with birth outcomes.

In order to address these gaps in the literature, this paper (1) examines the association between residential redlining and preterm birth (and decrease in gestational age), (2) examines the perceptions of stress, discrimination and neighborhood quality in association with preterm birth (and decrease in gestational age); and (3) examines residential redlining as a contributor to the black-white disparity in preterm birth (and gestational age). We hypothesize that women who live in higher redlined neighborhoods will tend to have a greater risk of preterm birth compared to women who live in lower redlined neighborhoods. Secondly, we hypothesize that women who report experiences of discrimination will have a greater risk for preterm birth compared to women who do not report discrimination. Thirdly, we hypothesize that women report low neighborhood quality will have a greater risk for preterm birth compared to women who report high neighborhood quality. We also hypothesize that women who report high levels of stress will have a greater risk of preterm birth compared to women who report low levels of stress. Finally, we hypothesize that residential redlining contributes to the disparity in preterm birth between black non-Hispanic women compared to white non-Hispanic women even after controlling for important covariates.

METHODS

Data Sources

This study links data from the Stress Pregnancy and Evaluation Community Project (SPEAC), Pennsylvania vital birth records, the Home Mortgage Disclosure Act (HMDA) database and the US Census. The SPEAC survey was from 1999-2004 by the Department of

Obstetrics and Gynecology at Jefferson Medical College, Thomas Jefferson University to investigate the relationship between chronic maternal stress and bacterial vaginosis (BV) for pregnant women enrolled at the time of their first prenatal clinic visit. The women received prenatal care from one of eight Philadelphia District Health Centers and two hospital-based clinics. Inclusion criteria for the SPEAC study were singleton gestation, intrauterine pregnancy, and English or Spanish speaking (25). All women regardless of foreign born status will be included in the initial analysis. The average gestational age at the time of BV screening and stress assessment was 14.8 weeks (26). This SPEAC survey includes information about the women's individual health, reports of stress and discrimination, demographic information, the census tracts in which they lived when the survey was collected, and the linked vital birth records. A total of 4880 pregnant women completed the SPEAC survey. Women who had miscarriages, still births or abortions would not have a birth certificate. As a result, survey information for 4130 (85%) SPEAC participants were successfully matched with the birth file. Out of those women, 3949 (81% of the 4880) had linked birth records and geocoded addresses and are included in the final analysis for this study.

The Home Mortgage Disclosure Act (HMDA) is an administrative database created by the Federal Reserve Board that collects yearly information from banks and other lending institutions providing mortgage loans. The residential redlining construct is derived from the HMDA for years 1999-2004. This dataset contains all loan dealings from financial institutions throughout the United State for a particular year and includes information about type and amount of loan, census tract of the property, loan disposition and characteristics of the applicant. This study excludes (1) incomplete applications that were not processed by

lending institutions and therefore could not be part of a measure for loan disposition bias; (2) properties that are not owner-occupied (3) home improvement loans; and (4) multi-family units (12). The analysis for this study only includes mortgage loans with information about the applicant's race and only those identified as black or white race. An index of residential redlining was created for each census tract in Philadelphia County and later linked with the census tracts in which the women lived who completed the Stress Pregnancy and Evaluation Community Project (SPEAC) survey. An average of 16,527 loans per year were included in the HMDA database between 1999-2004 in the analytic sample in Philadelphia County.

The third data source is the year 2000 US Census. The US Census was used to derive a measure for residential segregation based on the index of dissimilarity and to determine the percentage Black for each neighborhood in which the women in SPEAC lived.

Neighborhood Definition

The smallest neighborhood unit included in the HMDA database is the census tract. As a result, the definition of neighborhood for this study will be the census tracts within Philadelphia County. The addresses of women who participated in SPEAC were geocoded and assigned a census tract based on the US 2000 census boundaries.

Measures

Community Level Measures

Residential Redlining. Redlining is derived from the HMDA. The redlining measure is operationalized as black-white loan disposition and hence includes those who identified themselves as black or white. Loans that were missing information about the applicant's race were not included in the analysis. The *race* of the loan applicant will be the main predictor of loan disposition in this study. *Loan action taken,* (accepted/denied), describes whether or

not a loan was denied by a financial institution, will be used to create the redlining measure. The redlining measures were created for each year for all relevant census tracts for Philadelphia County. The redlining measures for the census tracts in Philadelphia County were compared across years to see if there were any significant mean changes in redlining between 1999 and 2004. A correlation matrix was used to compare the Bayes estimates of the random effects models for redlining in Philadelphia County over the six year period. Since there were temporal changes in redlining over the six year period, each participant in SPEAC will be given an index of redlining based on the census tract in which she lived and the year that she participated in the study. The redlining index scores ranged from 0.31 to 6.82 with a mean score of 1.95 and a median score of 1.88. A score of 2.0 is interpreted as a neighborhood where the odds of loan denial among blacks are twice the odds of loan denial among whites. Additional details for creating the redlining measures are described in Chapter 4.

Residential Segregation. The *Index of Dissimilarity* is a measure of residential segregation that quantifies the proportion of Blacks that would have to change their area of residence to achieve an even distribution of the population in census tracts. This index measures the level of evenness or differential distribution of groups across areal units (84). This index ranges from 0 to 1 and is a continuous measure stemming from the US Census and linked to the geocoded addresses of the women from the Stress Pregnancy and Evaluation Community Project (SPEAC). Additional segregation indices explored in this study include the exposure index and the isolations index. Calculations for these indices are described in further detail in Chapter 4.

Individual Perception Measures

Perceived Discrimination. SPEAC participants were asked about *perceived discrimination* based on everyday experiences of discrimination and major experiences of discrimination. Respondents were asked to rate the frequency of day to day experiences of discrimination because of "race, ethnicity, income level, social class, sex, gender, age sexual orientation, physical appearance or religion" (82). These experiences were rated on a six-point scale ranging from "never" to "almost every day." The total score was summed and analyses were conducted to determine the distribution of the scores and appropriate categorizations of the measure. The scores ranged from 0 to 43. The summed score was then categorized by level of discrimination: none (0 points), low (1-10 points), medium (11-20 points), high (21+ points). This was referred to as the *everyday discrimination* measure. These cutpoints were based on the cluster of individuals that had a score of zero and equal spaced categorizations for the remaining scores. The continuous form of this scale and the categorized form were also evaluated in this study. Respondents were also asked to answer "yes" or "no" to two questions about *major* experiences of discrimination. Those questions were: 1) "For unfair reasons, do you think that you have ever not been hired for a job?" and 2) "Have you ever been unfairly stopped, searched, questioned, physically threatened or abused by police?" These two questions were added together, resulting in 0, 1 or 2 major events. This was referred to as the *major discrimination* measure.

Perceived Stress. SPEAC participants were asked to complete a 14-item self-report Cohen Perceived Stress Scale (CPSS), which measures the degree to which a respondent appraises stressful circumstances along dimensions of unpredictability, uncontrollability and overload (83, 129). Examples of questions included in this scale are, "You have felt that you

were unable to control the important things in your life," "You have felt nervous or 'stressed'" and "You have felt that you were on top of things." Participants answers are based on a Likert scale to what degree the item relates to them in the past month (0=never, 1=almost never, 2=sometimes, 3=fairly often or 4=very often). A total CPSS is computed by summing across all items. The scores ranged from 0 to 51. This scale is suggested for examining the role of appraised stress in the etiology of disease (83). The CPSS has good internal reliability and fair test-retest reliability among college and community samples (83). The continuous form of this scale was analyzed as well as a categorized form of the scale. The categorized form of the scale was derived by summing across the questions and then dividing the summed score by the total number of answered questions. These scores were then categorized as 0, 1, 2, 3 or 4 based on the Likert scale. The final scores of 0-4 were also analyzed.

Neighborhood Quality. The SPEAC respondents answered specific questions about the quality of neighborhoods. The neighborhood quality scale was derived from Coulton, Korbin and Su's work on perceptions of neighborhoods in urban areas (126, 130). The scale included three core domains: crime and safety, physical disorder, and social disorder (126, 130). The SPEAC participants were asked, "Please tell me how often these things are a problem or are found in your neighborhood." Examples of neighborhood factors were little or trash on the sidewalks, vacant buildings and gunshots in the neighborhood. Respondents rated the neighborhood quality factors on a 10-point scale where 1 was rarely/not worried and 10 was frequently/very worried. A sum score was created for the 19 neighborhood quality factors for a range of scores of 1 to 190.

Additional Covariates

Several covariates were selected based on conceptual and theoretical models and were included in this analysis. These covariates were also considered to confound the relationship between preterm birth and neighborhood environment (146). Control of all of the following covariates, regardless of statistical significance or percent changes in estimates, were ultimately applied since model convergence was not compromised (131). Maternal Race/Ethnicity. SPEAC participants were asked to identify their race, which also included an option of Hispanic ethnicity. The classifications included in this study are non-Hispanic white, non-Hispanic black, Hispanic/Latina, Other. We also included age at interview as continuous variable (grand mean centered). Total household income was operationalized as income from jobs, public assistance, unemployment, SSI, from family/friends or other sources. This was a categorical variable where respondents chose an income range that best fit their circumstances. Education was categorized as less than high school, high school/GED or post-high school. Marital status was categorized as married/living as married or not married/not living as married. Variables such as tobacco and alcohol usage and parity have been found to be associated with preterm birth and perceived stress in previous studies but are not necessarily associated with selection into certain neighborhoods. However, it is speculated and has been found that neighborhood environments influence health behaviors and minority neighborhoods are more likely to have advertisements and outlets for alcohol and tobacco (145, 147-149). These covariates were included because they may also be related to preterm birth and individual stressors such as perceived discrimination, stress and neighborhood quality.

Primary Outcome

Preterm Birth and Gestational Age. The primary outcome of interest, preterm birth was primarily based on the clinical estimate of gestational age from the medical records and birth certificate for singleton infants born to the women who completed the survey. The gestational age estimation from the ultrasound was extracted from the women's medical records if the gestational age differed from the estimation from the birth records. If we could not find a reliable estimate from the birth record or medical record, the information was completed from phone calls to the participant. Almost four percent of the population had missing information for gestational age. Preterm birth was defined as less than 37 weeks completed gestation. The outcome will include both spontaneous and medically induced preterm birth. Ancillary analyses involving very preterm birth were also conducted, and very preterm birth was operationalized as less than 32 weeks gestation. Gestational age as a continuous outcome was also included to examine the change in gestational age in relation to neighborhood redlining and other important predictors. Since birth records have known limitations, medical records are ideal for capturing gestational age as well as other maternal factors (150).

Statistical Analyses

First, univariate analyses were conducted to determine the distribution of gestational age, the overall prevalence of preterm/very preterm birth outcomes and other covariates in this population. Bivariate analyses were conducted between preterm birth and residential redlining, segregation, reports of neighborhood quality, perceived discrimination and stress using tabular analyses and by comparing mean scores. The bivariate analyses were conducted to guide model construction for multivariate analyses and to assess the crude

relationships between variables. The Fisher exact test and exact p-values for various chi-square statistics were used to test if the aforementioned associations were statistically significant. The nonzero correlation statistic was used (Q_{CS}) to assess the relationships between the ordinal, categorical variables (87). Since the redlining variable and segregation index are both along a continuum, these associations were evaluated in both their categorical forms and continuous forms. Collinearity was assessed between the neighborhood level constructs such as residential redlining, segregation and percentage black as well as the perception scales such as discrimination, stress and neighborhood quality.

Overall sample and race-specific multilevel modeling techniques were applied to take into account the contribution of community-level factors over individual factors and to account for any clustering of birth outcomes. These analyses allow for estimation of the odds of preterm birth or the mean gestational age, integrating contextual factors and "borrowing strength" from clusters or census tracts with larger sample sizes (114, 151).

As mentioned previously, covariates were chosen based on substantive knowledge and the relationships between the variables as determined by conceptual models. Backwards elimination from the saturated model is not suggested due to issues of model convergence so a "step-up" strategy is preferred (88). Typically, in a fixed effects logistic regression model, adjustment for confounders is based on a change in more than 10 percent when comparing the crude odds ratio with the adjusted odds ratio. Changes in estimates were examined, however, theoretical models overrode this criteria. Adjustments for confounders in the multilevel linear regression model were also based on theoretical models and change in estimate of the main predictor, residential redlining (88).

In the multivariate multilevel models, the first level includes individual-level stressors such as perceived discrimination, perceived stress, and perceived poor neighborhood quality. Other important covariates such as race/ethnicity, age, maternal education and income were added to the model. The second level includes neighborhood-level variables. However, since residential redlining was operationalized as a fixed characteristic of the census tract that varied over the six year period of the SPEAC study, it was included as a level one predictor. Clusters are determined by the "neighborhood" unit of analysis (i.e. census tract). Random effects models with a fixed slope value for each predictor variable will be estimated with random intercepts specific to the unit of analysis (i.e. census tract) (39). The following describes multilevel linear regression models for gestational age as a continuous outcome and multilevel logistic regression models for preterm birth, a dichotomized outcome.

Continuous outcomes. Multilevel linear regression models for continuous outcomes with random intercepts will be employed for continuous gestational age. The two-level model is for the continuous outcome, Y_{ij}, for participant 'i' in neighborhood 'j' is shown below (43). Model specification will be as follows:

Level 1 equation:

$Y_{ij} = \beta_{0j} + \beta_{1j}\,(\text{redlining})_{1ij} + \beta_{2j}\,(\text{maternal stress})_{2ij} + \beta_{3j}\,(\text{neighborhood quality})_{3ij} + \beta_{4j}\,(\text{reports of discrim})_{4ij} + \beta_{pj}\,(x)_{pij}$

Where x represents other individual-level covariates and p is the index for individual-level covariates.

Level 2 equation:

$\beta_{0j} = \gamma_{00} + (Z)_{qj} + u_{0j}, \quad u_{0j} \sim N(0, t_{00})$

Where z represents important community-level covariates and q is the index for community-level covariates

Final model:

$Y_{ij} = \gamma_{00} + \beta_{1j}(\text{redlining})_{1ij} + \beta_{2j}(\text{maternal stress})_{2ij} + \beta_{3j}(\text{neighborhood quality})_{3ij} + \beta_{4j}(\text{reports of discrim})_{4ij} + \beta_{pj}(x)_{pij} + (Z)_{qj} + u_{0j}$

The final model can provide the mean adjusted gestational age for each level of categorized main exposures of interest. Additionally, we can determine whether gestational age increases or decreases as levels of redlining increase.

Binary outcomes. Multilevel logistic regression models for binary outcomes with random intercepts will be employed for all of the birth outcomes (preterm birth; very preterm birth vs. term birth). The models will essentially remain the same unless other confounders are unimportant. The two level model is for the binary outcome, preterm/very preterm birth versus term birth. The model will be specified as above, but modeling the log odds of preterm/very preterm birth (Log[p/1-p]). The logit link function will be used to model the associations between institutional racism, perceived discrimination, neighborhood quality, stress and birth outcomes. These models assume a non-Gaussian distribution for the random part in the level one model while simultaneously maintaining normality assumptions for the random part in level two (43). The final model can provide the odds of preterm birth for each level of the main exposures. Based on these analyses, we can determine whether an increase in the main exposures (i.e. redlining) increases or decreases the odds of preterm birth. SAS version 9.2 was used to complete all analyses.

RESULTS

Descriptive Results

Descriptive statistics and crude odds ratios and 95 percent confidence intervals for preterm birth (less than 37 weeks) are presented in Table 6.1. The SPEAC population included women with a range of income levels but with a greater percentage in the lower income categories, a large representation of non-Hispanic Black women, more than half with a high school education or greater, less than a quarter married, almost 40 percent nulliparous, about 20 percent smoked cigarettes during pregnancy, and almost one-third used alcohol. The majority of the population did not perceive discrimination, perceived a moderate amount of stress, and about one-third perceived their neighborhoods to be poor. The majority of the SPEAC population lived in neighborhoods with some degree of residential redlining (index greater than 1). The mean redlining index score among non-Hispanic black, Hispanic and non-Hispanic white women was 2.0, 1.8, and 1.9 respectively (results not shown). The mean perceived everyday discrimination score among non-Hispanic black, Hispanic and non-Hispanic white women was 5.3, 4.7, and 3.7 respectively (results not shown). The mean perceived stress scores showed a different pattern with scores of 22.5, 24.3, and 23.8 among non-Hispanic black, Hispanic and non-Hispanic white women respectively (results not shown). Finally, black non-Hispanic women had poorer ratings of their neighborhoods with scores of 73.7 compared to Hispanic (68.4) and non-Hispanic white women (53.3) (results not shown).

Bivariate Results

Almost 14 percent of the non-Hispanic black women had preterm births, and seven percent of non-Hispanic white women had preterm births. The odds of preterm birth among

Black women were two times the odds of preterm birth among white women. There were also significant racial/ethnic differences in the prevalence preterm birth at the 34 week gestation threshold and very preterm birth at the 32 week gestation threshold (results not shown) where 5 percent of non-Hispanic black women had a preterm births (34 week threshold) compared to 2.6 percent of non-Hispanic white women and 1.7 percent of Hispanic women. Three percent of non-Hispanic black women had very preterm births (32 weeks) compared to one percent of non-Hispanic white women and one percent of Hispanic women (results not shown). There was also a slight increased risk for preterm birth among women who were less educated, unmarried, tobacco users, and parous.

The first objective of this study was to examine the association between residential redlining and preterm birth (and gestational age). We hypothesized that women who lived in redlined neighborhoods would have a greater risk of preterm birth than women who did not live in redlined neighborhoods. The crude associations are presented in Table 6.1. We also examined segregation and percent black in relation to birth outcomes. We found a slightly higher mean residential redlining index among term births (1.95) compared to preterm births (1.90), slightly lower mean percentage of black neighborhoods among term (57.1%) versus preterm births (63.7%), and similar mean residential segregation indices when comparing term (0.40) versus preterm births (0.39). There was a slight, non-significant decreased risk in preterm birth among women who lived in neighborhoods with some degree of redlining (redlining index greater than one) compared to women who lived in non-redlined neighborhoods. We also examined the relationship between residential redlining and gestational age as a continuous outcome (Table 6.2). We also examined other neighborhood characteristics in association with gestational age. There was not a significant change in

gestational age as the indices for residential redlining and segregation increased. We found that an increase in percentage black on the neighborhood level was an important predictor of a decrease in gestational age.

Our second objective was to examine whether perceptions of discrimination, stress and neighborhood quality were associated with preterm birth. We hypothesized that women who report discrimination, stress and poor neighborhood quality would have an increased risk of preterm birth. Among the continuous perceptions measures, the mean scores for the perceptions of everyday discrimination (5.02 versus 5.43), stress (23.03 versus 22.79), and poor neighborhood quality scales (70.45 versus 68.91) were quite similar when comparing women with term versus preterm births respectively (Table 6.1). Among the categorized forms of the perception measures, there was a slight increased risk of preterm birth among women of medium and high perceptions of everyday discrimination (odds ratio (OR) = 1.11, 95 percent confidence interval (CI): 0.83, 1.48, and OR = 1.27, 95 % CI: 0.82, 1.96 respectively), one and two counts of major discrimination (OR= 1.08, 95% CI:0.82, 1.41, and OR= 1.41, 95% CI: 0.80, 2.47 respectively) and medium and high perceptions of stress (OR = 1.07, 95% CI: 0.70, 1.63, and OR = 1.18, 95% CI: 0.73, 1.90 respectively). There was not an overall increased risk of preterm birth with an increased perception of poor neighborhood quality. We also examined the perceptions of discrimination, stress and neighborhood quality in relation to continuous gestational age (Table 6.2). There was not a significant change in gestational age with an increase in perceptions of everyday and major discrimination, stress or poor neighborhood quality. Increased maternal age was associated with a slight decrease in gestational age, and a decrease in parity was associated with a slight increase in gestational age. There were also racial/ethnic differences in gestational age where

the average gestational age for non-Hispanic black women was lower (37.8 weeks) compared to non-Hispanic white women (38.6 weeks) and Hispanic women (38.2 weeks) (Table 6.2).

Before multivariate models were employed, correlations between individual level stressors and external stressors on the neighborhood level were examined (results included in Chapter 5). None of the individual or community level stressors were highly correlated and the Pearson's correlation coefficients ranged from -0.00107 to 0.258. The highest correlation was between perceived neighborhood quality and percent black on the neighborhood level.

Multivariate Results

Table 6.2 includes adjusted multilevel linear models for gestational age for all women in the population and stratified by racial/ethnic group, and Table 6.3 includes adjusted multilevel logistic models for preterm birth. In an intercepts only multilevel logistic regression model, we find that among the neighborhoods in Philadelphia in which the SPEAC population lives, the preterm birth rate is 11 percent (results not shown). We examined the relationship between residential redlining and birth outcomes. Overall, redlining showed little to no association with birth outcomes for all women or for each racial/ethnic group. For all women, residential redlining was not associated with continuous gestational age (b= 0.019) or preterm birth (OR=0.93, 95% CI: 0.79, 1.09). For non-Hispanic white women, there was a modest, non-significant association between living in redlined neighborhoods and preterm birth (OR=1.14, 95% CI: 0.73, 1.78).

We also examined whether perceptions of stress, discrimination or neighborhood quality was associated with preterm birth. Among all women, these perceptions measures were not associated with continuous gestational age or preterm birth as a dichotomous outcome. Among non-Hispanic Black women, an increase in age was associated with a

decrease in gestational age (b= -0.045, p<0.001). Among non-Hispanic white women, an increase in perceived stress was associated with a decrease in gestational age (b= -0.97, p<0.001), strongly associated with preterm birth (OR=6.57, CI: 1.67, 25.91), and low levels of education were associated with a decrease in gestational age (No High School: b= -1.14, p<0.01; High School: b=-0.46). There were no important predictors among the Latina population. Among all women, we found increased maternal age and an increase in educational level was associated with a decrease in gestational age (Table 6.2).

Our final objective was to examine whether residential redlining explained the racial/ethnic differences in preterm birth. Residential redlining nor any other community-level explained the racial/ethnic differences in preterm birth even after controlling for covariates (Tables 6.2 and 6.3).

DISCUSSION

The measurement of neighborhood, contextual factors on perinatal health was explored through the development of an index for residential redlining. Many health studies rely on US Census data when developing neighborhood, contextual variables, and this study applied an administrative dataset, the Home Mortgage Disclosure Act (HMDA) database, which is rarely used in health contexts. One previous study applied census-stratified fixed effects models to develop an index of residential redlining in relation to health among Chinese-Americans (12). This is the first study of its kind to apply random effects multilevel modeling to develop an index of residential redlining in relation to perinatal health and as a possible contributor to the black-white disparity in preterm birth.

Overall, we found no significant associations between residential redlining and preterm birth for all women in the study and stratified by racial/ethnic group, although there

was a non-significant protective effect among non-Hispanic black women and Hispanic women. Even after adjustment for covariates, residential redlining did not explain the racial/ethnic disparities in preterm birth. These findings were unexpected. We hypothesized that women living in redlined areas would be more susceptible to external stressors through their neighborhood environments, thus resulting in preterm birth.

There are several possible explanations for this lack of effect. One explanation could be that residential redlining has no effect on the risk of preterm birth or change in gestational age. Although this may be empirically true in this study, previous studies have shown an association between residential redlining and general health as well as residential segregation and birth outcomes (12, 100, 101, 145). A second explanation for these findings could be the instability of the Bayes' estimates produced from the random-effects models for creating the redlining index. Although multilevel models allow us to "borrow strength" across units where some units may have limited information (114), there may be a significant number of census tracts with a limited number of loan dealings or loan dealings from both black and white applicants. Another explanation is the lack of variability of neighborhoods in which the participants in SPEAC live. This explanation is supported in this study because the majority of the census tracts represented in this study were considered redlined (index greater than 1). Additionally, the mean redlining score for the census tracts within the population was almost 2. Other unmeasured mediating factors may be along the causal pathway from residential redlining and preterm birth, influencing the relationships actually measured in this study.

We also found that preterm birth or increased gestational were not associated with perceptions of stress, discrimination or poor neighborhood quality among all women. We

found a positive, significant association between preterm birth and perceived stress among white women only. White women in general had the highest perceived stress scores compared to the women of other racial/ethnic groups. The lack of association between the perception measures and preterm birth are opposite of what was expected and of findings from previous studies (46, 47, 56, 94). The perceptions measures used in this study may not be specific enough to capture stress, particularly among this population. The Cohen Perceived Stress Scale used in this study was initially validated among predominantly college samples but then also applied among other populations (83). The perceived discrimination scale is a conglomerate of previous discrimination scales, but the one utilized in this study is non-specific in that it captures discrimination based on several social markers, not just racial discrimination. This lack of specificity makes it difficult to detect if the respondent has been primarily discriminated against because of their race, gender, sexual orientation or some other social marker. Additionally, the individual and institutional stress measures included in this study may be specific to preterm birth subtypes such as preterm labor versus medically induced preterm birth (137). This study included all preterm births, regardless of indication.

The population of women in the SPEAC study, particularly the non-Hispanic white women, is quite unique compared to other pregnant women in Philadelphia and nationally. For example, births to unmarried women in Philadelphia in 2001 to 2002 for non-Hispanic blacks, non-Hispanic whites and Hispanics was 74.3, 19.5 and 61.2 percent respectively (136). Among the SPEAC population, this was 83.5, 74.7, 55.8 respectively. Smoking during pregnancy for women in Philadelphia in 2001 to 2002 for non-Hispanic blacks, non-Hispanic whites and Hispanics was 11.7, 12.6 and 9.9 percent respectively (136). Among the SPEAC population, this was 20.2, 50.7, and 13.6 respectively. Compared to data of vital

birth records of women in Philadelphia who gave birth in 2001, the women in SPEAC were younger, more likely to be non-Hispanic black, less educated, and less likely to be married (126). The preterm birth rate from 2001-2002 for non-Hispanic black, non-Hispanic white and Hispanic women in the metropolitan Philadelphia area is 15.7, 8.1, and 11.8 percent respectively (136). The white women in the SPEAC study have a preterm birth rate slightly higher than the rate found in the city.

A large percentage of the women in the SPEAC study are Hispanic. Almost 9 percent of the population in Philadelphia is Hispanic with a majority of Puerto Rican descent (152).

There were several limitations to this study. Census tracts as administrative units are operationalized as communities or neighborhoods although these particular boundaries may not truly reflect neighborhoods in Philadelphia County. However, there are no other boundaries or reflections of neighborhood available for either the US Census or the HMDA. Since the SPEAC cohort is a clinic-based sample, pregnant women may be excluded who do not seek prenatal care or have access to prenatal care. To address this issue, SPEAC participants were recruited from both public and private clinics for a range of socioeconomic backgrounds. However, the overall population characteristics may limit whether this study can be generalized to other populations.

Despite these limitations, this is the first study to our knowledge to examine residential redlining as a form of institutional racism in relation to birth outcomes. Additionally, psychosocial measures that are lacking in studies that rely in birth certificate data allow us to explore individual and contextual factors simultaneously. This study also examined gestational age as a continuous outcome and the commonly used categorization of gestational age in the form of preterm birth.

In conclusion, institutional racism may be an important construct in understanding racial/ethnic inequities in health. Although residential redlining as a measure of institutional racism was not associated with birth outcomes among this population, future studies examining neighborhood contextual factors should consider its applications in other geographical areas, among other populations and in relation to other health outcomes.

TABLES

Table 6.1: Prevalence of preterm birth according to characteristics of participants in the total sample, SPEAC 1999-2004

	Total Population	**Preterm Birth** N=453 (11.94%)	**Term Birth** N=3342 (88.06%)	**Preterm Birth Rate**	**Crude OR (95% CI)**
Categorical Variables (N and %)	**N (%)**	**N (%)**	**N (%)**		
Race/Ethnicity					
Black NH	2661 (67.44)	354 (78.15)	2182 (65.35)	13.96	2.13 (1.40, 3.25)
White NH	364 (9.22)	25 (5.52)	328 (9.82)	7.08	(1.0)
Hispanic	803 (20.35)	60 (13.25)	727 (21.77)	7.62	1.08 (0.67, 1.76)
Other	118 (2.99)	14 (3.09)	102 (3.05)	12.07	1.80 (0.90, 3.60)
Missing	3				
Income					
$5,000	718 (20.28)	78 (19.02)	617 (20.72)	11.22	(1.0)
$5,000-9,999	526 (14.86)	78 (19.02)	430 (14.44)	15.35	1.44 (1.02, 2.01)
$10,000-14,999	470 (13.28)	52 (12.68)	394 (13.23)	11.66	1.04 (0.72, 1.52)
$15,000-19,999	444 (12.54)	48 (11.71)	378 (12.69)	11.27	1.00 (0.69, 1.47)
$20,000-24,999	413 (11.67)	48 (11.71)	342 (11.48)	12.31	1.11 (0.76, 1.63)
$25,000-29,999	292 (8.25)	32 (7.80)	246 (8.26)	11.51	1.03 (0.67, 1.59)
$30,000-34,999	246 (6.95)	34 (8.29)	203 (6.82)	14.35	1.33 (0.86, 2.04)
$35,000-39,000	148 (4.18)	12 (2.93)	128 (4.30)	8.57	0.74 (0.39, 1.40)
$40,000+	283 (7.99)	28 (6.83)	240 (8.06)	10.45	0.92 (0.58, 1.46)
Missing	409				
Education					
Less than HS	1516 (38.45)	176 (38.85)	1288 (38.60)	12.02	1.07 (0.80, 1.42)
HS Grad/GED	1711 (43.39)	200 (44.15)	1448 (43.39)	12.14	1.08 (0.82, 1.43)
Post-HS	716 (18.16)	77 (17.00)	601 (18.01)	11.36	(1.0)
Missing	5				
Marital Status					
Married/ Cohabiting	946 (23.97)	93 (20.53)	829 (24.81)	10.09	0.78 (0.62, 0.99)
Not Married	3000	360 (79.47)	2513	12.53	(1.0)

	Total Population	**Preterm Birth** N=453 (11.94%)	**Term Birth** N=3342 (88.06%)	**Preterm Birth Rate**	**Crude OR (95% CI)**
	(76.03)		(75.19)		
Missing	0				
Tobacco Use During Pregnancy					
No	3093 (78.58)	337 (74.72)	2632 (78.92)	11.35	0.79 (0.63, 0.99)
Yes	843 (21.42)	114 (25.28)	703 (21.08)	13.95	(1.0)
Missing	10				
Recent Alcohol Use					
No	2560 (64.97)	291 (64.52)	2175 (65.16)	11.80	0.97 (0.79, 1.19)
Yes	1380 (35.03)	160 (35.48)	1163 (34.84)	12.09	(1.0)
Missing	6				
Parity					
None	1559 (41.76)	179 (41.44)	1338 (42.17)	11.80	0.86 (0.68, 1.09)
One	1071 (28.69)	110 (25.46)	918 (28.93)	10.70	0.77 (0.59, 1.00)
Two or More	1103 (29.55)	143 (33.10)	917 (28.90)	13.49	(1.0)
Missing	213				
Perceived Discrimination (Everyday Discrimination)					
0	1683 (44.52)	209 (46.14)	1474 (44.30)	12.42	(1.0)
1-10	1405 (37.17)	147 (32.45)	1258 (37.81)	10.46	0.82 (0.66, 1.03)
11-20	515 (13.62)	70 (15.45)	445 (13.38)	13.59	1.11 (0.83, 1.48)
21+	177 (4.68)	27 (5.96)	150 (4.51)	15.25	1.27 (0.82, 1.96)
Missing	15				
Perceived Discrimination (Major Discrimination)					
No Events	3238 (82.31)	365 (80.57)	2738 (82.30)	11.76	(1.0)

	Total Population	**Preterm Birth** N=453 (11.94%)	**Term Birth** N=3342 (88.06%)	**Preterm Birth Rate**	**Crude OR (95% CI)**
One Event	600 (15.25)	73 (16.11)	509 (15.30)	12.54	1.08 (0.82, 1.41)
Two Events	96 (2.44)	15 (3.31)	80 (2.40)	15.79	1.41 (0.80, 2.47)
Missing	15				
Perceived Stress					
0-1.5 (Low)	234 (6.19)	26 (5.79)	208 (6.24)	11.11	(1.0)
>1.5-2.5 (Medium)	3003 (79.38)	353 (78.62)	2650 (79.48)	11.75	1.07 (0.70, 1.63)
>2.5-4 (High)	546 (14.46)	70 (15.59)	476 (14.28)	12.82	1.18 (0.73, 1.90)
Missing	12				
Perceived Poor Neighborhood Quality					
1	736 (19.42)	85 (18.76)	651 (19.51)	11.55	(1.0)
2	641 (16.92)	81 (17.88)	560 (16.79)	12.64	1.11 (0.80, 1.53)
3	613 (16.18)	83 (18.32)	530 (15.89)	13.54	1.20 (0.87, 1.66)
4	536 (14.15)	57 (12.58)	479 (14.36)	10.63	0.91 (0.64, 1.30)
5	412 (10.87)	49 (10.82)	363 (10.88)	11.89	1.03 (0.71, 1.50)
6	590 (15.57)	68 (15.01)	522 (15.65)	11.53	1.00 (0.71, 1.40)
7	261 (6.89)	30 (6.62)	231 (6.92)	11.49	1.00 (0.64, 1.55)
Missing	7				
Residential Redlining					
0-1	327 (8.72)	49 (10.96)	278 (8.41)	14.98	(1.0)
>1-1.5	691 (18.42)	86 (19.24)	605 (18.31)	12.45	0.81 (0.5, 1.18)
>1.5-2	1203 (32.06)	131 (29.31)	1072 (32.44)	10.89	0.69 (0.49, 0.99)
>2-2.5	773 (20.60)	101 (22.60)	672 (20.33)	13.07	0.85 (0.59, 1.23)
>2.5-3	415 (11.06)	46 (10.29)	369 (11.16)	11.08	0.71 (0.46, 1.09)
>3-3.5	230 (6.13)	21 (4.70)	209 (6.32)	9.13	0.57 (0.33, 0.98)
>3.5-7	113 (3.01)	13 (2.91)	100 (3.03)	11.50	0.74 (0.39, 1.42)
Missing	46				

Continuous Variables (mean value and range)	Mean (Range)	Mean (Range)	Mean (Range)		
Residential Redlining Index	1.95 (0.31-6.81)	1.90 (0.39-4.80)	1.95 (0.30-6.81)		
Residential Segregation (Dissimilarity Index)	0.40 (0.0099-0.93)	0.39 (0.14-0.82)	0.40 (0.0099-0.93)		
Residential Segregation (Exposure Index)	0.18 (0.0021, 0.95)	0.16 (0.0021, 0.89)	0.18 (0.0021, 0.95)*		
Residential Segregation (Isolation Index)	0.64 (0.0082, 0.98)	0.69 (0.052, 0.98)	0.63 (0.0082, 0.98)***		
Percentage Black Non-Hispanic Residents	58.02% (0.71-98.38%)	63.73% (0.97-98.38%)	57.05% (0.71-98.38%)		
Perceived Discrimination (Everyday)	5.00 (0-43)	5.43 (0-32)	5.02 (0-43)		
Perceived Stress	22.99 (0-51)	22.79 (0-46)	23.03 (0-51)		
Perceived Neighborhood Quality	70.17 (17-190)	68.91 (19-174)	70.45 (17-190)		
Age	24 (14-44)	24.85 (14-44)	23.98 (14-44)		

<0.05, *<0.01, *****<0.001**

Table 6.2: Coefficients and standard errors for Multilevel Linear Models predicting gestational age, SPEAC 1999-2004

	All Women					Black Women Only	White Women Only	Latinas Only
	Crude Association	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 4**	**Model 4**	**Model 4**
Intercept	38.57 (0.046)	38.55 (0.12)	40.03 (0.48)	39.83 (0.37)	39.95 (0.53)	39.09 (0.66)	42.92 (1.41)	38.50 (0.93)
Residential Redlining	0.033 (0.058)	0.033 (0.058)	--	-0.020 (0.065)	0.019 (0.067)	0.035 (0.088)	-0.21 (0.17)	0.077 (0.13)
Percentage Black	-0.56 (0.12)***	---	--	0.016 (0.18)	-0.045 (0.18)	-0.026 (0.24)	-0.35 (0.60)	0.071 (0.38)
Residential Segregation (Dissimilarity Index)	0.43 (0.34)	---	--	0.52 (0.39)	0.34 (0.40)	0.51 (0.57)	-0.58 (0.90)	-0.11 (0.70)
Perceived Everyday Discrimination	-0.022 (0.050)	---	0.0037 (0.059)	---	0.0054 (0.059)	-0.081 (0.076)	0.33 (0.19	0.13 (0.11)
Perceived Major Discrimination	-0.15 (0.091)	---	-0.13 (0.10)	---	-0.14 (0.10)	-0.15 (0.13)	0.55 (0.32)	-0.13 (0.20)
Perceived Stress	-0.033 (0.094)	---	-0.0057 (0.11)		-0.034 (0.11)	0.13 (0.14)	-0.97 (0.28)***	0.0053 (0.21)
Perceived Neighborhood Quality	-0.0069 (0.019)	---	0.032 (0.022)		0.037 (0.023)	0.028 (0.030)	0.045 (0.073)	0.023 (0.039)
Age	-0.025 (0.0074)***	–	-0.033 (0.01)***	-0.031 (0.0083)***	-0.034 (0.010)***	-0.045 (0.013)***	-0.021 (0.028)	0.013 (0.019)
Marital Status (not married)								
Married/Cohabiting	0.12 (0.098)	---	-0.0037 (0.11)	0.032 (0.11)	-0.0070 (0.12)	0.082 (0.17)	0.37 (0.29)	-0.067 (0.17)
Education (Post-HS)		---						
No HS	-0.13 (0.12)	---	-0.32 (0.14)*	-0.36 (0.14)**	-0.37 (0.15)**	-0.28 (0.17)	-1.14 (0.41)**	-0.25 (0.27)
HS Grad/GED	-0.11 (0.12)	---	-0.24 (0.13)	-0.22 (0.13)	-0.28 (0.13)*	-0.25 (0.20)	-0.46 (0.39)	-0.29 (0.27)
Total Household Income (Under $5000)								
$5,000-9,999	-0.21 (0.15)	---	-0.19 (0.16)	-0.18 (0.15)	-0.18 (0.16)	-0.27 (0.22)	-0.25 (0.56)	0.030 (0.24)
$10,000-14,999	0.088 (0.16)	---	0.063 (0.17)	0.11 (0.16)	0.058 (0.17)	0.21 (0.23)	-0.87 (0.52)	-0.052 (0.29)
$15,000-19,999	0.12 (0.16)		0.17 (0.17)	0.12 (0.16)	0.17 (0.17)	0.26 (0.23)	-0.81 (0.53)	0.12 (0.28)
$20,000-	0.033	---	0.0098	0.047	0.0061	-0.11	0.12	0.50

	All Women					Black Women Only	White Women Only	Latinas Only
	Crude Association	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 4**	**Model 4**	**Model 4**
24,999	(0.17)		(0.18)	(0.17)	(0.18)	(0.23)	(0.52)	(0.37)
$25,000-29,999	0.11 (0.19)	---	0.10 (0.19)	0.18 (0.19)	0.13 (0.20)	0.096 (0.25)	0.26 (0.62)	0.19 (0.38)
$30,000-34,999	-0.22 (0.20)	---	-0.16 (0.21)	-0.22 (0.20)	-0.17 (0.21)	-0.067 (0.27)	-0.76 (0.62)	-0.56 (0.42)
$35,000-39,000	0.20 (0.24)	---	0.21 (0.25)	0.22 (0.25)	0.23 (0.26)	0.29 (0.32)	-0.93 (0.67)	0.64 (0.66)
$40,000+	0.24 (0.19)		0.21 (0.20)	0.19 (0.20)	0.20 (0.20)	0.18 (0.27)	0.26 (0.52)	0.53 (0.50)
Alcohol Use (Ref: Yes)	0.023 (0.088)	---	-0.012 (0.10)	---	-0.015 (0.10)	-0.020 (0.13)	-0.034 (0.26)	0.057 (0.20)
Tobacco Use (Ref: Yes)	0.18 (0.10)	---	0.16 (0.12)	---	0.17 (0.12)	0.20 (0.16)	0.25 (0.26)	-0.26 (0.25)
Parity (2 or more)								
None	0.26 (0.10)**	---	-0.12 (0.13)	---	-0.14 (0.13)	-0.29 (0.18)	0.14 (0.39)	0.26 (0.23)
One	0.27 (0.11)**	---	0.044 (0.13)	---	0.033 (0.13)	0.071 (0.17)	-0.24 (0.36)	0.059 (0.22)
Race/Ethnicity (White NH)								
Black NH	-0.78 (0.14)***	-0.77 (0.15)***	-0.81 (0.18)***	-0.71 (0.19)***	-0.76 (0.20)***	---	---	---
Latina/Hispanic	-0.33 (0.17)*	-0.31 (0.17)	-0.33 (0.20)	-0.19 (0.20)	-0.27 (0.21)	---	---	---
Other	-0.37 (0.28)	-0.38 (0.28)	-0.24 (0.32)	-0.24 (0.31)	-0.21 (0.32)	---	---	---
ICC (Empty Model)	0.0095							

ICC- Intraclass correlation

Table 6.3: Odds Ratios and 95% Confidence Intervals for Unit-Specific Multilevel Logistic Regression Models predicting preterm birth, SPEAC 1999-2004

	All Women				Black Women	White Women	Hispa-nic Women
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 4**	**Model 4**	**Model 4**
Residential Redlining	0.88 (0.77, 1.02)	0.95 (0.81, 1.1)	---	0.93 (0.79, 1.09)	0.93 (0.77, 1.12)	0.68 (0.25, 1.88)	0.76 (0.46, 1.28)
Percentage Black	---	0.91 (0.61, 1.38)	---	1.00 (0.65, 1.56)	1.02 (0.63, 1.67)	2.91 (0.21,40. 35)	0.88 (0.19, 4.14)
Residential Segregation (Dissimilarity Index) [++]	---	0.50 (0.19, 1.32)	---	0.57 (0.21, 1.57)	0.57 (0.17, 1.95)	[+++]	0.60 (0.035, 10.54)
Perceived Everyday Discrimination	---	---	1.00 (0.87, 1.14)	1.00 (0.87, 1.15)	1.09 (0.93, 1.27)	0.90 (0.36, 2.24)	0.80 (0.51, 1.25)
Perceived Major Discrimination	---	---	1.11 (0.87, 1.40)	1.11 (0.87, 1.41)	1.04 (0.79, 1.35)	3.58 (0.83, 15.52)	1.23 (0.56, 2.69)
Perceived Stress	---	---	1.03 (0.80, 1.32)	1.05 (0.82, 1.35)	0.87 (0.65, 1.15)	6.57 (1.67, 25.91)	2.18 (0.97, 4.89)
Perceived Neighborhood Quality	---	---	0.94 (0.89, 0.99)	0.93 (0.88, 0.99)	0.93 (0.87, 0.99)	[+++]	0.99 (0.85, 1.16)
Age	---	1.03 (1.01, 1.05)	1.03 (1.01, 1.05)	1.03 (1.01, 1.05)	1.02 (1.00, 1.06)	[+++]	1.02 (0.95, 1.09)
Marital Status (not married)	---						
Married/Cohabiting	---	0.90 (0.68, 1.18)	0.94 (0.70, 1.25)	0.91 (0.68, 1.22)	0.97 (0.68, 1.38)	0.32 (0.06, 1.71)	1.08 (0.56, 2.08)
Education (Post-HS)							
No HS	---	1.36 (0.97, 1.90)	1.33 (0.93, 1.90)	1.38 (0.96, 1.98)	1.10 (0.73, 1.64)	[+++]	3.04 (0.76, 12.13)
HS Grad/GED	---	1.15 (0.84, 1.57)	1.17 (0.85, 1.62)	1.18 (0.85, 1.64)	0.94 (0.66, 1.35)	[+++]	4.26 (1.12, 16.27)
Total Household Income (Under $5000)							
$5,000-9,999	---	1.36 (0.96, 1.93)	1.34 (0.93, 1.93)	1.35 (0.94, 1.96)	1.78 (1.15, 1.69)	1.43 (0.07, 30.26)	0.56 (0.22, 1.41)
$10,000-14,999	---	0.95 (0.65, 1.41)	1.05 (0.70, 1.56)	1.05 (0.70, 1.57)	1.15 (0.71, 1.86)	2.93 (0.32, 27.19)	0.58 (0.18, 1.87)
$15,000-19,999	---	0.94	0.88	0.89	0.95	8.38	0.67

	All Women				Black Women	White Women	Hispa-nic Women
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 4**	**Model 4**	**Model 4**
		(0.63, 1.40)	(0.58, 1.34)	(0.58, 1.36)	(0.57, 1.57)	(0.75, 93.59)	(0.23, 1.94)
$20,000-24,999	---	1.01 (0.68, 1.52)	1.06 (0.69, 1.60)	1.06 (0.70, 1.62)	1.37 (0.84, 2.21)	1.07 (0.05, 23.08)	0.29 (0.035, 2.30)
$25,000-29,999	---	0.87 (0.55, 1.39)	0.96 (0.60, 1.53)	0.92 (0.57, 1.48)	1.01 (0.58, 1.76)	2.82 (0.13, 60.63)	0.51 (0.10, 2.53)
$30,000-34,999	---	1.26 (0.80, 1.99)	1.26 (0.79, 2.03)	1.28 (0.80, 2.06)	1.21 (0.69, 2.14)	3.66 (0.21, 63.35)	2.88 (0.90, 9.27)
$35,000-39,000	---	0.68 (0.35, 1.31)	0.65 (0.33, 1.29)	0.65 (0.32, 1.30)	0.65 (0.30, 1.43)	13.85 (0.87, 219.84)	[+++]
$40,000+	---	0.89 (0.54, 1.42)	0.83 (0.50, 1.39)	0.83 (0.50, 1.39)	0.94 (0.52, 1.69)	1.40 (0.11, 18.37)	[+++]
Alcohol Use (Ref: Yes)	---	---	1.04 (0.82, 1.33)	0.97 (0.76, 1.23)	0.97 (0.74, 1.27)	2.67 (0.78, 9.15)	1.26 (0.54, 2.93)
Tobacco Use (Ref: Yes)	---	---	0.79 (0.60, 1.05)	1.29 (0.97, 1.71)	0.74 (0.54, 1.03)	0.85 (0.26, 2.81)	1.89 (0.59, 6.01)
Parity (2 or more)							
None	---	---	1.23 (0.90, 1.69)	1.21 (0.89, 1.66)	1.24 (0.87, 1.78)	1.56 (0.27, 9.17)	0.95 (0.37, 2.39)
One	---	---	0.96 (0.71, 1.29)	0.96 (0.70, 1.30)	0.92 (0.65, 1.31)	1.32 (0.27, 6.74)	1.02 (0.45, 2.34)
Race/Ethnicity (White NH)							
Black NH	2.13 (1.38, 3.27)	2.07 (1.23, 3.48)	2.34 (1.41, 3.88)	2.25 (1.30, 3.92)	---	---	---
Latina/Hispanic	1.05 (0.64, 1.72)	0.93 (0.53, 1.62)	1.17 (0.65, 2.09)	1.05 (0.58, 1.91)	---	---	---
Other	1.75 (0.87, 3.53)	1.50 (0.67, 3.35)	1.55 (0.68, 3.56)	1.50 (0.64, 3.48)	---	---	---
ICC (Empty Model)[+]	0.0356						

[+]ICC- the intraclass correlation is calculated from the empty model where sigma^2=pi^2/3
[+++]Insufficient data to produce effect estimates

CHAPTER 7: CONCLUSION

Summary of Findings

The purpose of this dissertation was to examine the effects of institutional racism on the perceptions of stressors and preterm birth among a cohort of pregnant women. Previous studies have examined individual perceptions of stress and discrimination in relation to preterm birth and low birth weight, and some studies have also examined social and contextual factors in relation to similar birth outcomes. Yet, there is limited research examining institutional forms of racism as a contextual factor having influence on birth outcomes as well as other individual stressors that may lead to adverse birth outcomes. No studies to our knowledge have examined residential redlining in housing as an institutional form of racism in relation to preterm birth. By examining these relationships, we can potentially provide an understanding of the social and contextual factors that influence pregnancy and birth above and beyond individual choices or behaviors. Additionally, this study and similar studies may provide insight into future research, interventions and policy aimed at understanding and addressing inequities in health.

In Chapter 4 (Manuscript 1), we developed an index for residential redlining and examined the extent to which residential redlining existed in the neighborhoods among a group of pregnant women in Philadelphia, PA. We also examined the association between redlining and perceived discrimination and residential segregation and percent black on the census tract level. We found that the majority of the women in the SPEAC population lived in redlined neighborhoods as defined in this study. There were racial/ethnic differences in

residence in redlined neighborhoods among this population; however, residential redlining was not associated with the respondents' perceptions of everyday discrimination. Residential redlining was moderately positively associated with residential segregation (black-white index of dissimilarity) and percentage of non-Hispanic blacks on the census tract level. The previous study on residential redlining and health among Chinese-Americans that found redlined areas to have lower dissimilarity scores, more whites, fewer Chinese Americans, and more individuals of higher socioeconomic status than non-redlined areas (12). The same study also found that respondents living in redlined areas were more likely to report discrimination compared to those living in non-redlined areas (12). Contrary to the current dissertation findings, another study found a relationship between reports of discrimination and "objective" measures of discrimination (153).

Next, in Chapter 5 (Manuscript 2), we examined the relationship between residential redlining and perceptions of discrimination, stress and neighborhood quality. We found that an increase in redlining was associated with perceptions of poor neighborhood quality among all women. Previous studies have found associations between "objective" measures of neighborhood characteristics and perceptions of neighborhoods (40, 102, 126, 130). In our study, we did not find an association between redlining and perceived stress or discrimination among all women. However, among non-Hispanic white women, an increase in redlining was associated with a decrease in perceptions of discrimination. This finding was opposite of what was expected and could be due to the unique characteristics of the non-Hispanic white population included in this sample. Additionally, the measures used to capture perceptions of stress and discrimination may not have been specific enough or applicable to the minority populations in this sample.

Lastly, in Chapter 6 (Manuscript 3), we examined the relationship between residential redlining and preterm birth as well as the relationship between preterm birth and perceptions of stress, discrimination and neighborhood quality. We found a slightly higher mean residential redlining index among term births (1.95) compared to preterm births (1.90), but these differences were not statistically significant. There were black-white differences in preterm birth even after adjustment for residential redlining and other covariates. Residential segregation, perceptions of stress, discrimination and neighborhood quality were not significantly associated with preterm birth. These findings are contrary to many studies examining these same relationships (20, 44, 61, 62, 94, 101, 154, 155). Additionally, one study examining redlining and health found redlining actually predicted better general health status among a population of Chinese-Americans (12).

Strengths and Limitations

Our overall dissertation objective was to examine the relationship between residential redlining and preterm birth and determine if residential redlining contributed to the disparity. This study did not provide evidence that redlining was associated with preterm birth or contribute to the preterm birth disparity. There are several limitations that pose as challenges for this study. Self report of unfair treatment could potentially be a sensitive topic creating reporting bias. There may be underreporting or over reporting of unfair treatment as a result. In general, all self-reports of data collected by surveys have the potential for reporting bias. This is a limitation in public health research that is addressed during survey collection and less frequently in analysis. Misclassifications of experiences of discrimination are difficult to address once data has already been collected. However, this study aims to address one

component of this challenge by introducing "objective" institutional forms of discrimination (redlining and residential segregation) that do not rely on self-report.

The SPEAC cohort is a clinic-based population from various clinics throughout an urban area. Clinic-based studies have the potential to exclude sectors of the population that may not seek or have access to health services such as prenatal care. As a result, the proposed study may exclude vulnerable women who may be more likely to experience racism, biasing the results. To address this issue, the original study recruited women from a variety of socioeconomic backgrounds at both public and private clinics. Although the SPEAC study is based in an urban area where lending institutions are normally required to report under the HMDA, not all institutions are required to file if they do not meet the minimum requirements. As a result, the redlining measures created from the HMDA may be incomplete in neighborhoods that receive loans from institutions that do not meet the reporting requirements. Since the area of the study is a metropolitan area, this should not be a significant problem. Another limitation stems from the use of the HMDA data for the years 1999-2002. There were slight changes in the census tract boundaries such as one block being included in the 2000 census tract boundary and perhaps not in the 1990 census tract boundary. This is a limitation although many of the tract boundary changes were minor.

Another limitation relates to the study design. In a cross-sectional study, the direction of causation cannot be determined. However, we hypothesized that racism and perceptions of stress influenced birth outcomes, especially since information about perceptions was collected before the women had given birth. Finally, the SPEAC cohort includes mostly Black women following by Hispanic women, representing a greater proportion than the actual population of women in Philadelphia. This may influence the generalizability of this

study to other populations. However, this over-sampling allows for an analysis of all women as well as separate analyses for Black women and Hispanic women.

There are also several strengths of the study. This study is the first to utilize existing administrative databases such as the HMDA to investigate the social context of birth and pregnancy. We were able to create a measure for institutional racism in the form of redlining. Future public health research has the potential to employ institutional measures such as redlining in understanding other health outcomes. Persistent racial/ethnic health inequities exist in the US and this study has the potential to elucidate the factors contributing to these inequities. Since the women included in the study all live in an urban center, women living in rural settings are not included. However, the methods applied in this study could be replicated to understand the effects of redlining and segregation simultaneously on preterm birth, whether redlining and segregation contribute to perceived stressors and how these factors contribute to racial and ethnic inequities in preterm birth in urban areas. Finally, the SPEAC survey includes important information such as experiences of discrimination, stress and neighborhood quality information that the birth certificate alone does not include. This additional information can provide insight about the relationships between individual risk factors, perceptions of life stressors and structural factors as influences on health outcomes.

Public Health Significance, Policy Implications, and Practice

This study supports the argument that some forms of institutional racism are associated with preterm birth above and beyond individual factors or self-report of stressors. Although residential redlining was not associated with preterm birth or change in gestational age, certain measures of residential segregation were. Previous studies have examined the relationships between various indices for measuring residential segregation in association

with preterm birth. This study expands this line of research by examining a new measure for institutional racism and examining its association with preterm birth and perceptions measures for stress, discrimination and neighborhood quality. The effects of institutional racism on health are important to understand and elucidate if we are to eliminate existing racial/ethnic health disparities.

Understanding the experiences of pregnant women, particularly the unique experiences of black women in the US, will provide insight into the black-white inequities in perinatal outcomes. The current everyday experiences of these women were captured in this study through measures of perceived stress, discrimination and neighborhood quality. The social environments of these women were also captured through the perception measures in addition to "objective" measures of stressors such as institutional racism in the form of residential segregation and redlining. Inclusion of the segregation and redlining measures allow us to examine pervasive discriminatory practices affecting the communities in which these women live. Although redlining was not found to be associated with preterm birth in this study, it is plausible that residential redlining and segregation shapes neighborhood opportunities and resources that directly and indirectly influence health.

In addition to connecting neighborhood context to health outcomes, these same contextual factors potentially influence perceptions of day to day experiences with racism. According to a 2003 Gallup poll, two in five blacks felt discriminated against at least once a month and one in five felt discriminated against everyday (156). However, an ABC/Washington post poll found in early 2009 that twice as many blacks as whites thought racism was a problem in the US, and twice as many whites as blacks thought that blacks had achieved racial equality (156). Although there aforementioned polls show differences in

opinions about experiences of racism and equality in the US, the reality is that there are stark racial/ethnic inequities in health, educational attainment, acquisition of wealth, and the criminal justice system to name a few. More recently in housing, minority populations were more likely to receive subprime and high rate mortgages compared to their white counterparts even when other factors such as credit, income and employment histories were similar (70). These present day discriminatory practices not only influence accumulation of wealth through home ownership but potentially lead to depressed and abandoned communities, and homelessness.

According to the 2000 US Census, the average non-Hispanic white person in the Philadelphia metropolitan area lives in a neighborhood where the median value of an owned home is $149,260 while the median value for a non-Hispanic black, Hispanic or non-Hispanic Asian/Pacific Islander is $69,174, $78,185, $126,776 respectively (152). Although the present study did not evaluate the relationships between residential redlining and housing values or community level poverty, other institutional forms of racism such as residential segregation point to inequities in wealth and concentrated poverty, particularly among minority communities (74, 90).

If institutional forms of racism on the community-level and reports of other stressors are linked to health outcomes, including but not limited to birth outcomes, certain policy options could be considered. Practices related to residential redlining and segregation promote and perpetuate inequities in neighborhood conditions. These inequities could be alleviated through policies that enforce equitable practices in housing, community development, and neighborhood planning. A review of housing programs such as the Section 8 Voucher program and mixed-income housing programs found that the voucher

program provided families with additional opportunities to move to neighborhoods with less exposure to violence. However, there were no systematic evaluations of the mixed-income housing programs to draw conclusions on its effects on families. The task force responsible for the review recommended collaborations between public health and housing to ensure affordable housing and increased safety in neighborhood environments for families in need (157).

Present studies examine the existence of racial/ethnic inequities and the relationships between various forms of racism and health, but an important question is to understand how to prevent or eradicate racism. In 2001, the United Nations held the "World Conference on Racism, Racial Discrimination, Xenophobia, and Other Forms of Intolerance" in Durban, South Africa to examine governmental action or inaction in eradicating racism. Unfortunately, the US withdrew from the conference due to "anti-Jewish rhetoric" by other participants at the conference (158). Participation would have allowed the US to examine and measure current policies and practices in relation to goals established across many nations in relation to racism. However, the current government has issued a statement indicating its commitment to addressing racism, particularly in the criminal justice system, hate crimes and racial profiling in law enforcement (159). In addition to national efforts, local policy efforts should be considered. "Undoing Racism" workshops have been implemented in public health departments and other health agencies by guiding institutional leaders through a curriculum that examines the manifestations of racism, where it exists, racism as a determinant of health inequities, and future action (160). Although this curriculum has been implemented in traditional health institutions, institutions outside of public health or healthcare could consider applying these concepts. Interventions such as

these have the potential to influence individuals who develop policies and programs in the health or housing arenas for example; in addition to expanding practitioner's understanding of the long history and legacy of racism and inequitable opportunities for certain populations in the US.

Future Research

Future public health research should examine plausible contributors to racial/ethnic health inequities and the pathways leading to an excess in morbidity and mortality. Several approaches will be implemented to continue in this line of research. First, this study discusses the various pathways leading to adverse birth outcomes. In order to elucidate these pathways, mediation analyses will be considered, particularly the perception measures as mediators between institutional racism and health. Additionally, structural equation modeling may be a useful technique in understanding these complex relationships. Future research in this area should also consider alternative ways of operationalizing residential redlining on the community level. Historical redlining and present day housing discrimination may both be important factors in understanding neighborhood contextual issues and its effects on health. Finally, future research can apply these neighborhood contextual factors in other studies that examine other health outcomes and among other populations.

APPENDIX A: CHAPTER 4

Table A.1 Selected Characteristics of Home Mortgage Loans, HMDA Dataset 1999-2004

		1999	2000	2001	2002	2003	2004
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Loan Denied	**Yes**	1,891 (12.1)	1,898 (11.6)	1,364 (9.7)	1190 (8.0)	1179 (10.0)	2343 (11.4)
	No	13,499 (86.1)	14,208 (82.7)	12,479 (89.1)	13,419 (90.1)	15,578 (88.0)	17,790 (86.8)
	Missing	282 (1.8)	277 (1.7)	163 (1.2)	277 (1.9)	352 (2.0)	372 (1.8)
	Total	15,672	16,383	14,006	14,886	17,709	20,505
Race of Applicant	**Black**	6717 (42.9)	7228 (44.1)	5732 (40.9)	5559 (37.3)	6317 (35.7)	6324 (30.8)
	White	8955 (57.1)	9155 (55.9)	8274 (59.1)	9327 (62.7)	11,392 (64.3)	14,181 (69.2)
	Total	15,672	16,383	14,006	14,886	17,709	20,505
Sex of Applicant	**Male**	8850 (56.5)	9005 (55.0)	7916 (56.5)	8291 (55.7)	10,016 (56.6)	11,804 (57.6)
	Female	6809 (43.4)	7275 (44.4)	6066 (43.3)	6556 (44.0)	7594 (42.9)	8630 (42.1)
	Missing	13 (0.1)	103 (0.6)	24 (0.2)	39 (0.3)	99 (0.5)	71 (0.3)
	Total	15,672	16,383	14,006	14,886	17,709	20,505
Type of Loan	**Conventional**	10247 (65.4)	10,919 (66.6)	8673 (61.9)	9833 (66.1)	13,381 (75.6)	17,736 (86.5)
	FHA-insured	5010 (32.0)	5152 (31.4)	5064 (36.2)	4839 (32.5)	4125 (23.3)	2618 (12.8)
	VA-guaranteed	395 (2.5)	296 (1.8)	266 (1.9)	211 (1.4)	203 (1.1)	151 (0.7)
	Farmer's Home Administration	20 (0.1)	14 (0.1)	3 (0.02)	3 (0.02)	0	0
	Missing	0	2 (0.01)	0	0	0	0
	Total	15,672	16,383	14,006	14,886	17,709	20,505
Income of Applicant (in thousands)	**Mean (Std Dev)**	46.9 (59.2)	49.9 (80.7)	51.1 (57.9)	54.4 (61.1)	59.3 (83.9)	64.5 (100.6)
	Median	35.0	37.0	38.0	41.0	45.0	49.0
	Mode	30.0	30.0	30.0	30.0	36.0	48.0
	Missing	370	643	676	532	1278	827
Amount of	**Mean (Std**	72.1	76.2	80.8	89.8	106	124.3

		1999	2000	2001	2002	2003	2004
Loan	**Dev)**	(58.3)	(66.6)	(66.1)	(72.1)	(85.5)	(102.8)
(in thousands)	**Median**	60.0	61.0	64.0	71.0	83.0	96.0
	Mode	50.0	50.0	50.0	50.0	60.0	50.0
	Missing	0	0	0	0	0	0

Table A.2: Bivariate relationship between loan denial and applicant's race for conventional loans including the odds ratio and 95% confidence interval, HMDA 1999-2004

Loan Denied									
	1999			**2000**			**2001**		
	Yes	**No**	**Odds Ratio (95% C.I.)**	**Yes**	**No**	**Odds Ratio (95% C.I.)**	**Yes**	**No**	**Odds Ratio (95% C.I.)**
Applicant's Race									
Black	901	2619	2.99 (2.68, 3.34)	978	2759	3.44 (3.09, 3.84)	626	1822	3.78 (3.32, 4.29)
White	670	5832		650	6318		510	5608	
Total N	1571	8451		1628	9077		1136	7430	
	2002			**2003**			**2004**		
	Yes	**No**	**Odds Ratio (95% C.I.)**	**Yes**	**No**	**Odds Ratio (95% C.I.)**	**Yes**	**No**	**Odds Ratio (95% C.I.)**
Applicant's Race									
Black	463	1983	3.16 (2.76, 3.62)	794	2777	3.31 (2.97, 3.69)	1030	3624	2.96 (2.70, 3.25)
White	494	6688		756	8764		1116	11625	
Total N	957	8671		1550	11541				

Table A.3: Bivariate relationship between loan denial and applicant's race for FHA-insured loans only including the odds ratio and 95% confidence interval, HMDA 1999-2004

Loan Denied									
	1999			2000			2001		
	Yes	No	Odds Ratio (95% C.I.)	Yes	No	Odds Ratio (95% C.I.)	Yes	No	Odds Ratio (95% C.I.)
Applicant's Race									
Black	209	2612	1.84 (1.43, 2.37)	173	3019	1.28 (0.98, 1.69)	139	2936	1.19 (0.89, 1.59)
White	89	2048		81	1819		74	1862	
Total N	298	4660		254	4838		213	4798	
	2002			2003			2004		
	Yes	No	Odds Ratio (95% C.I.)	Yes	No	Odds Ratio (95% C.I.)	Yes	No	Odds Ratio (95% C.I.)
Applicant's Race									
Black	143	2736	1.30 (0.97, 1.73)	154	2350	1.61 (1.19, 2.18)	119	1329	1.64 (1.19, 2.27)
White	73	1816		61	1500		59	1083	
Total N	216	4552		215	3850		178	2412	

Table A.4: Bivariate relationship between loan denial and applicant's race for VA-guaranteed loans only including the odds ratio and 95% confidence interval, HMDA 1999-2004

Loan Denied									
	1999			2000			2001		
	Yes	No	Odds Ratio (95% C.I.)	Yes	No	Odds Ratio (95% C.I.)	Yes	No	Odds Ratio (95% C.I.)
Applicant's Race									
Black	11	198	0.95 (0.39, 2.29)	9	164	0.89 (0.32, 2.45)	9	114	1.76 (0.61, 5.10)
White	10	171		7	113		6	134	
Total N	21	369		16	277		15	248	
	2002			2003			2004		
	Yes	No	Odds Ratio (95% C.I.)	Yes	No	Odds Ratio (95% C.I.)	Yes	No	Odds Ratio (95% C.I.)
Applicant's Race									
Black	10	94	1.50 (0.55, 4.11)	7	107	0.75 (0.25, 2.22)	14	61	3.12 (1.06, 9.17)
White	7	99		7	80		5	68	
Total N	17	193		14	187		19	129	

Table A.5: Number of Participants in the SPEAC study by year of participation

	1999	2000	2001	2002	2003	2004	Total
N (%)	564 (14.28)	927 (23.47)	1050 (26.59)	499 (12.64)	663 (16.79)	246(6.23)	3949 (100)

Table A.6: Fixed Effects and other Beta estimates using GLIMMIX Procedure for the Multilevel Logistic Regression Model for Redlining, HMDA 1999-2004

		1999	2000	2001	2002	2003	2004
	ICC**	0.1045	0.1469	0.0724	0.1201	0.0477	0.0779
	t00	0.3839	0.5665	0.2567	0.4492	0.1649	0.2779
	t10	-0.3444	-0.4803	-0.2180	-0.4971	-0.1305	-0.2005
	t11	0.5856	0.7106	0.4752	0.7419	0.3683	0.2884
	corr*	-0.7264	-0.7570	-0.6242	-0.8611	-0.5296	-0.7084
Intercept	**Estimate**	-1.8858	-1.7282	-1.8157	-2.1347	-1.9972	-1.9876
	Std Error	0.1155	0.1198	0.1285	0.1353	0.1072	0.09304
	T Value	-16.33	-14.43	-14.13	-15.78	-18.64	-21.36
	P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
BWrace	**Estimate**	0.6591	0.6314	0.6153	0.5492	0.8037	0.8146
	Std Error	0.08551	0.09101	0.09087	0.00790	0.07637	0.06822
	T Value	7.71	6.94	6.77	5.16	10.55	11.94
	P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
AmtLoan	**Esti-mate**	-0.00496	-0.00637	-0.00834	-0.00396	-0.00381	-0.00225
	Std Error	0.000869	0.000882	0.000955	0.000779	0.000547	0.000380
	T Value	-5.71	-7.22	-8.74	-5.09	-6.69	-5.91
	P-value	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
SexApp	**Estimate**	-0.08454	-0.1263	-0.1191	-0.1522	-0.06004	-0.08292
	Std Error	0.05352	0.05094	0.06229	0.06517	0.05360	0.04717
	T Value	-1.58	-2.48	-1.91	-2.34	-1.12	-1.76
	P-value	0.1142	0.0132	0.0558	0.0196	0.2627	0.0788
Income	**Esti-mate**	0.001020	0.000187	0.002006	0.000774	0.000177	0.000478
	Std Error	0.000534	0.000327	0.000642	0.000732	0.000391	0.000225
	T Value	1.91	0.57	3.12	1.06	0.45	2.13
	P-value	0.0560	0.5679	0.0018	0.2903	0.6512	0.0335

****ICC- the intraclass correlation is calculated from the empty model where $sigma^2=pi^2/3$**

***corr= correlation between random intercepts and slopes**

Table A.7: Descriptive Statistics for the Beta Estimates of Fixed Effects added to Random Effects for the Multilevel Logistic Regression Model for Redlining, HMDA 1999-2004

		1999	2000	2001	2002	2003	2004
	N	350	392	350	342	362	366
Intercept	**Mean (Std Dev)**	-1.863 (0.329)	-1.697 (0.405)	-1.802 (0.221)	-2.111 (0.346)	-1.988 (0.176)	-1.969 (0.299)
	Min	-2.691	-2.715	-2.558	-3.047	-2.689	-2.848
	Max	-0.637	-0.297	-1.068	-0.984	-1.320	-0.950
BWrace	**Mean (Std Dev)**	0.652 (0.391)	0.617 (0.416)	0.617 (0.305)	0.532 (0.438)	0.808 (0.273)	0.806 (0.242)
	Min	-1.186	-0.950	-0.517	-1.139	-0.0393	0.0716
	Max	1.59	1.919	1.410	1.546	1.791	1.622
Odds Ratio (Bwrace)	**Mean (Std Dev)**	2.060 (0.754)	2.009 (0.809)	1.938 (0.575)	1.861 (0.781)	2.328 (0.655)	2.304 (0.555)
	Min	0.305	0.387	0.596	0.320	0.961	1.074
	Max	4.908	6.817	4.100	4.692	5.998	5.063

Table A.8: Correlation Matrix of the Estimates for the Intercepts (Fixed Effects added to Random Effects) for the Multilevel Logistic Regression Model for Redlining, HMDA 1999-2004

	1999	**2000**	**2001**	**2002**	**2003**	**2004**
1999	1.0					
2000	0.26938	1.0				
2001	0.28589	0.32218	1.0			
2002	0.32476	0.25780	0.25076	1.0		
2003	0.32321	0.29423	0.34250	0.13504	1.0	
2004	0.30078	0.30266	0.29508	0.16519	0.29126	1.0

***Note: Missing Values were excluded; All are significant at p<0.01**
N=308

Table A.9: Correlation Matrix of Estimates for the Race Variable (Fixed Effects added to Random Effects) for the Multilevel Logistic Regression Model for Redlining, HMDA 1999-2004

	1999	**2000**	**2001**	**2002**	**2003**	**2004**
1999	1.0					
2000	0.1967	1.0				
2001	0.31267	0.26933	1.0			
2002	0.29475	0.24908	0.21190	1.0		
2003	0.25583	0.23714	0.29984	0.27970	1.0	
2004	0.32146	0.24396	0.26924	0.20568	0.27820	1.0

***Note: Missing Values were excluded; All are significant at p<0.01**
N=308

Figure A.1: Map of Residential Redlining in Census Tracts in Philadelphia County, HMDA 1999

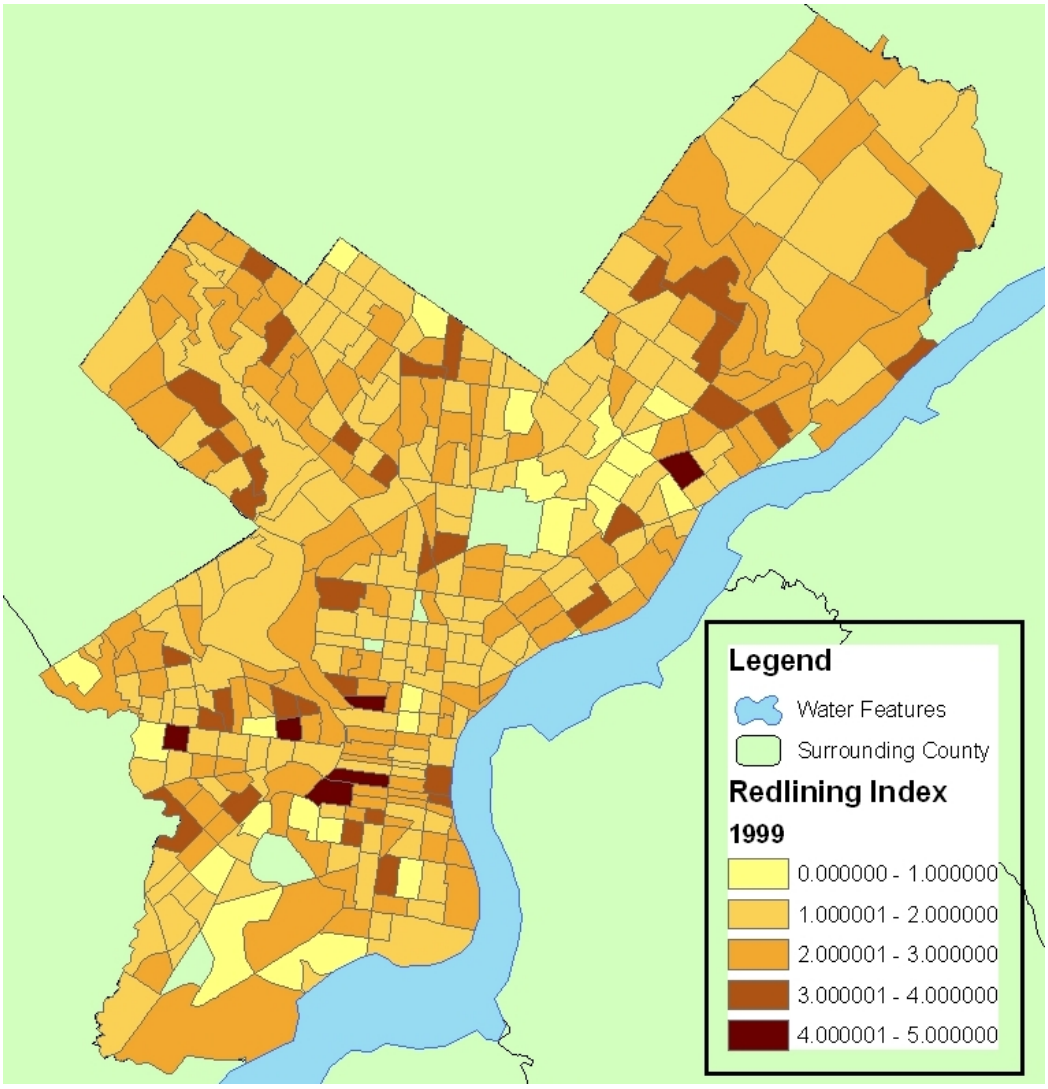


Figure A.2: Map of Residential Redlining in Census Tracts in Philadelphia County, HMDA 2001

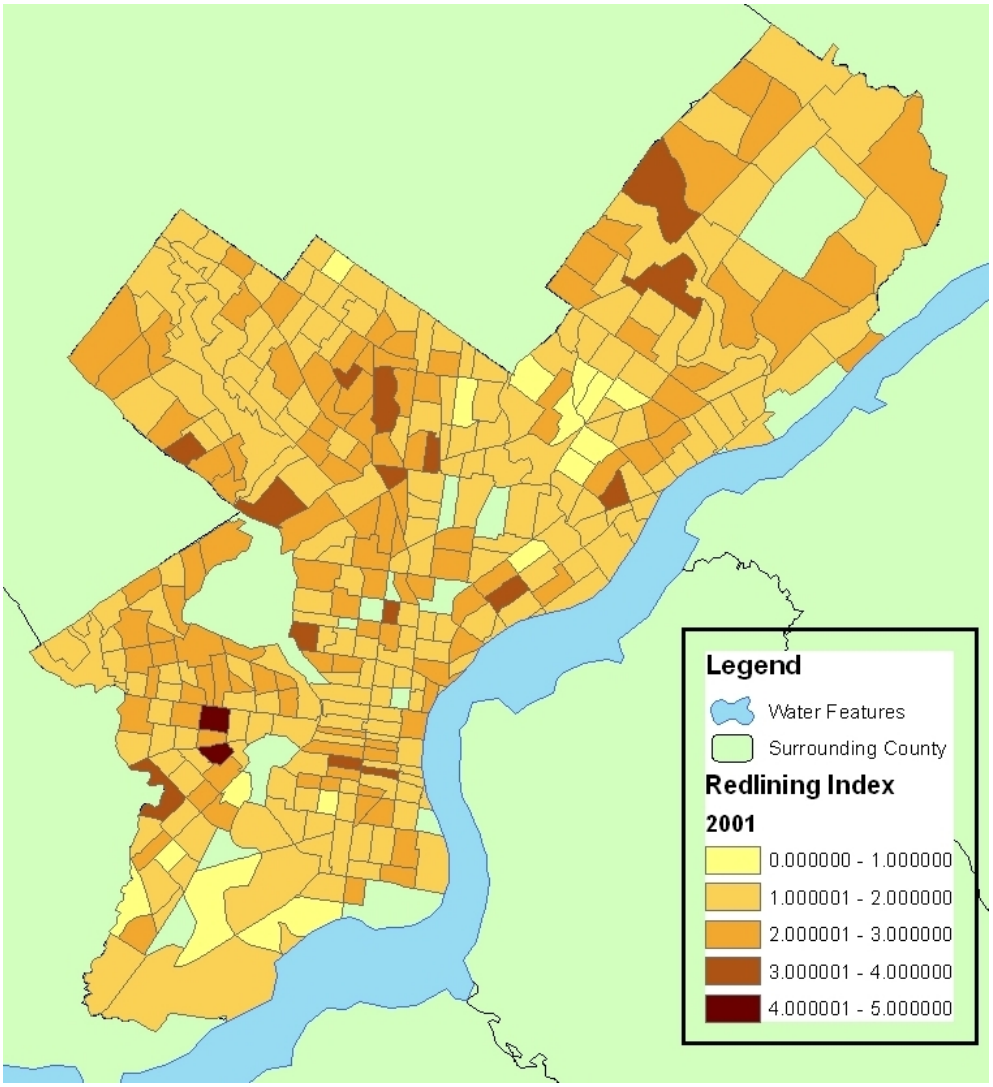


Figure A.3: Map of Residential Redlining in Census Tracts in Philadelphia County, HMDA 2002

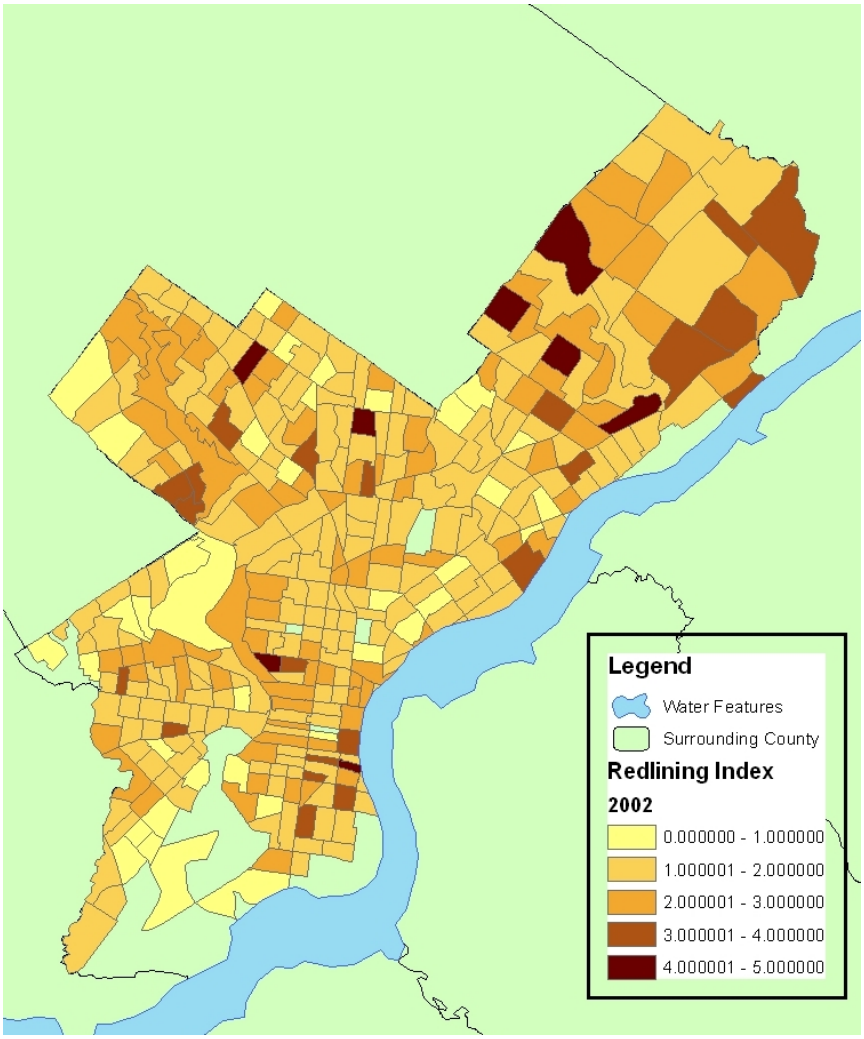


Figure A.4: Map of Residential Redlining in Census Tracts in Philadelphia County, HMDA 2003

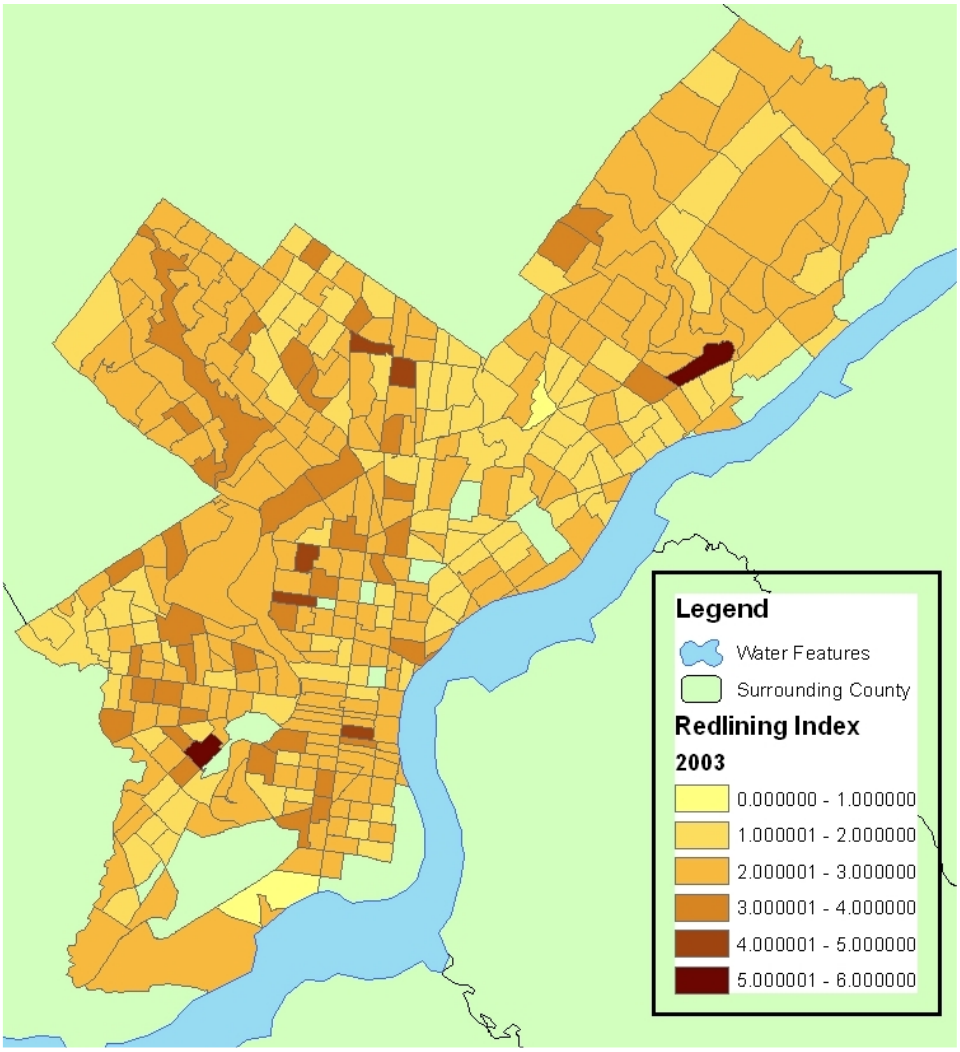


Figure A.5: Map of Residential Redlining in Census Tracts in Philadelphia County, HMDA 2004

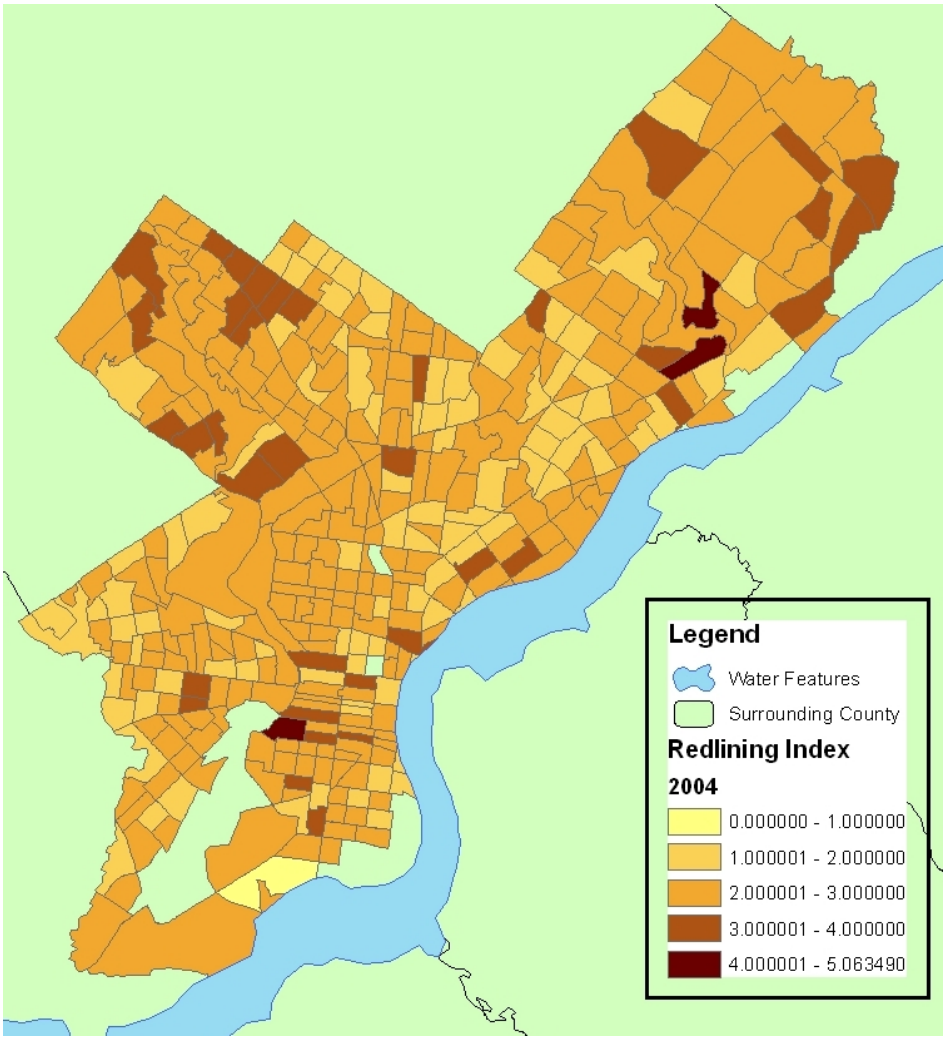


Figure A.6: Map of Percentage Black in Census Tracts in Philadelphia County and Location of SPEAC Participants, US Census 2000 & SPEAC 1999-2004

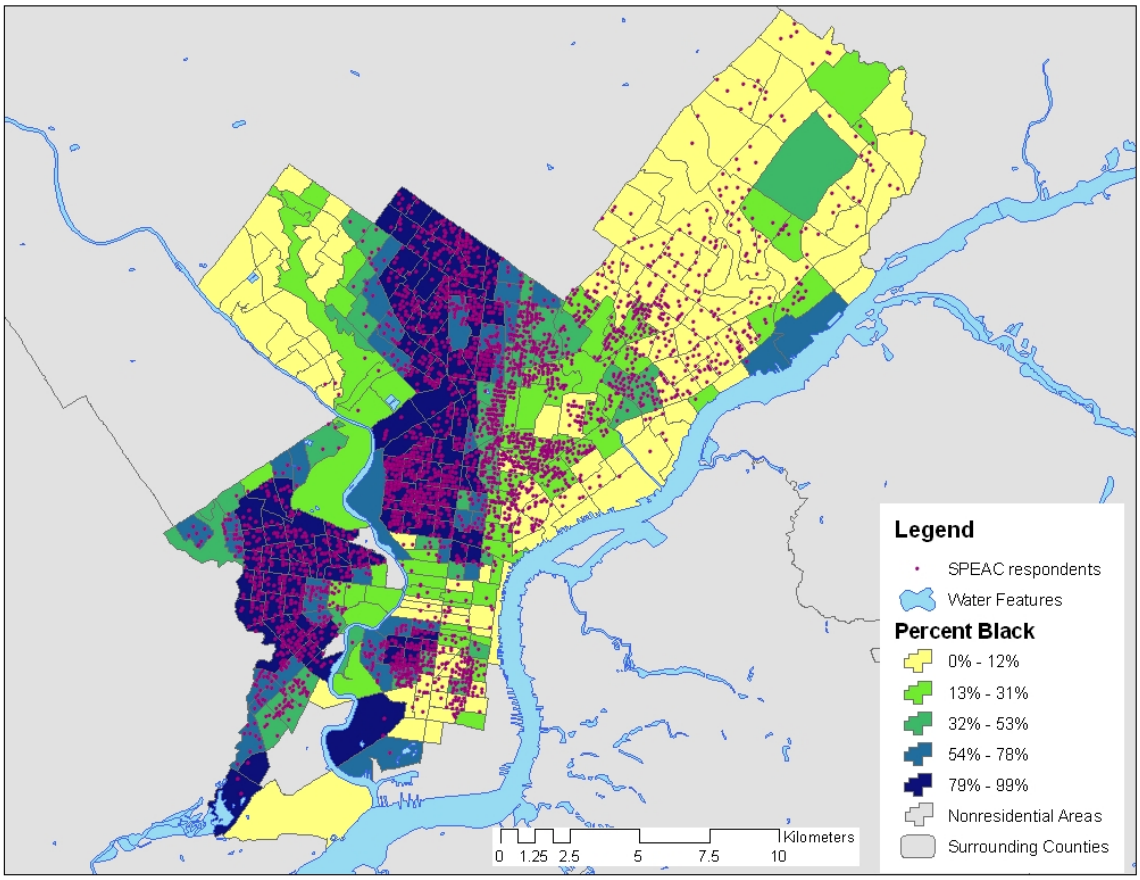


Figure A.7: Distributions of Random Intercepts and Random Effects for race for each census tract for the Multilevel Logistic Regression Model, HMDA 1999

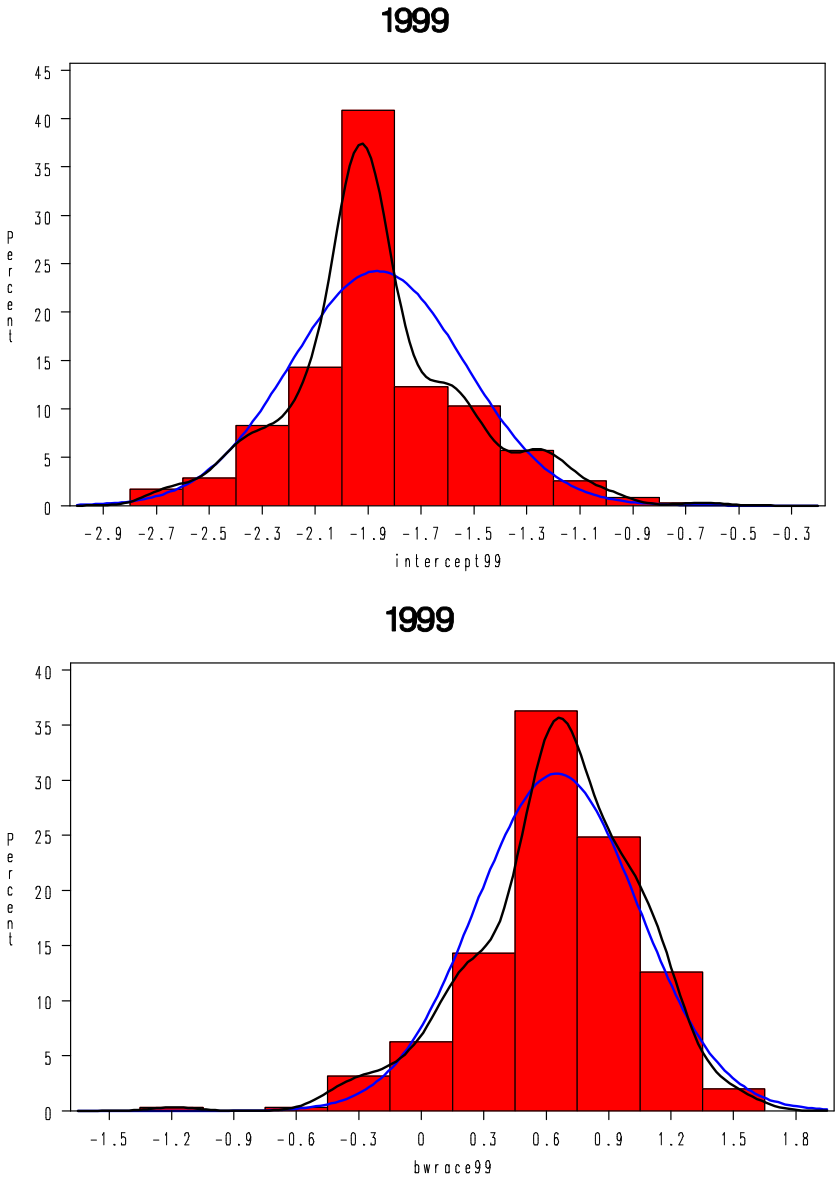
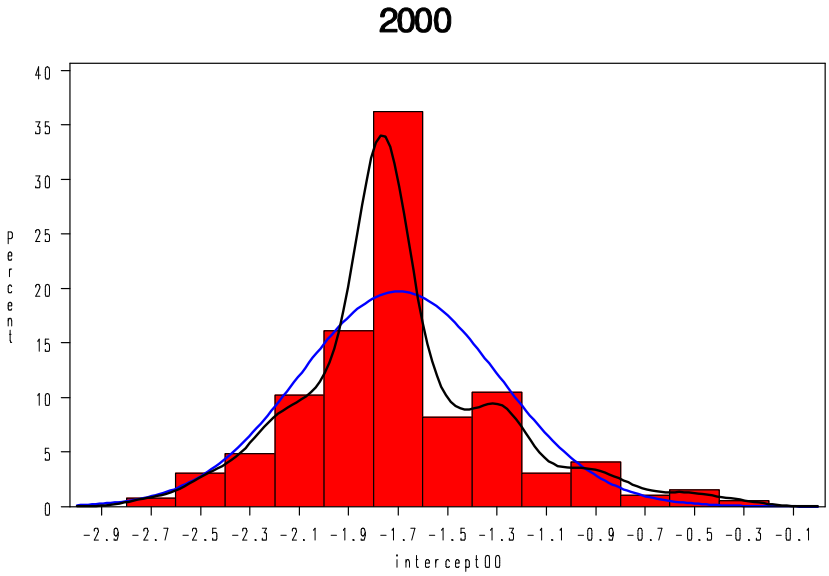


Figure A.8: Distributions of Random Intercepts and Random Effects for race for each census tract for the Multilevel Logistic Regression Model, HMDA 2000



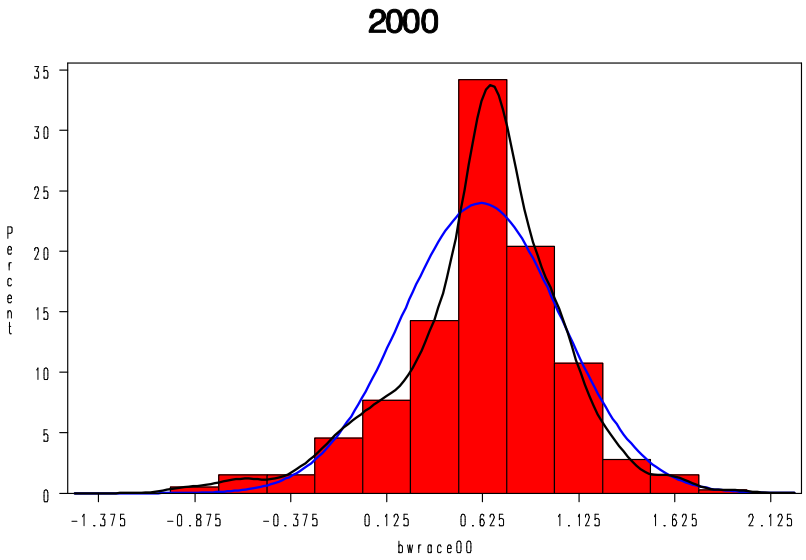


Figure A.9: Distributions of Random Intercepts and Random Effects for race for each census tract for the Multilevel Logistic Regression Model, HMDA 2001

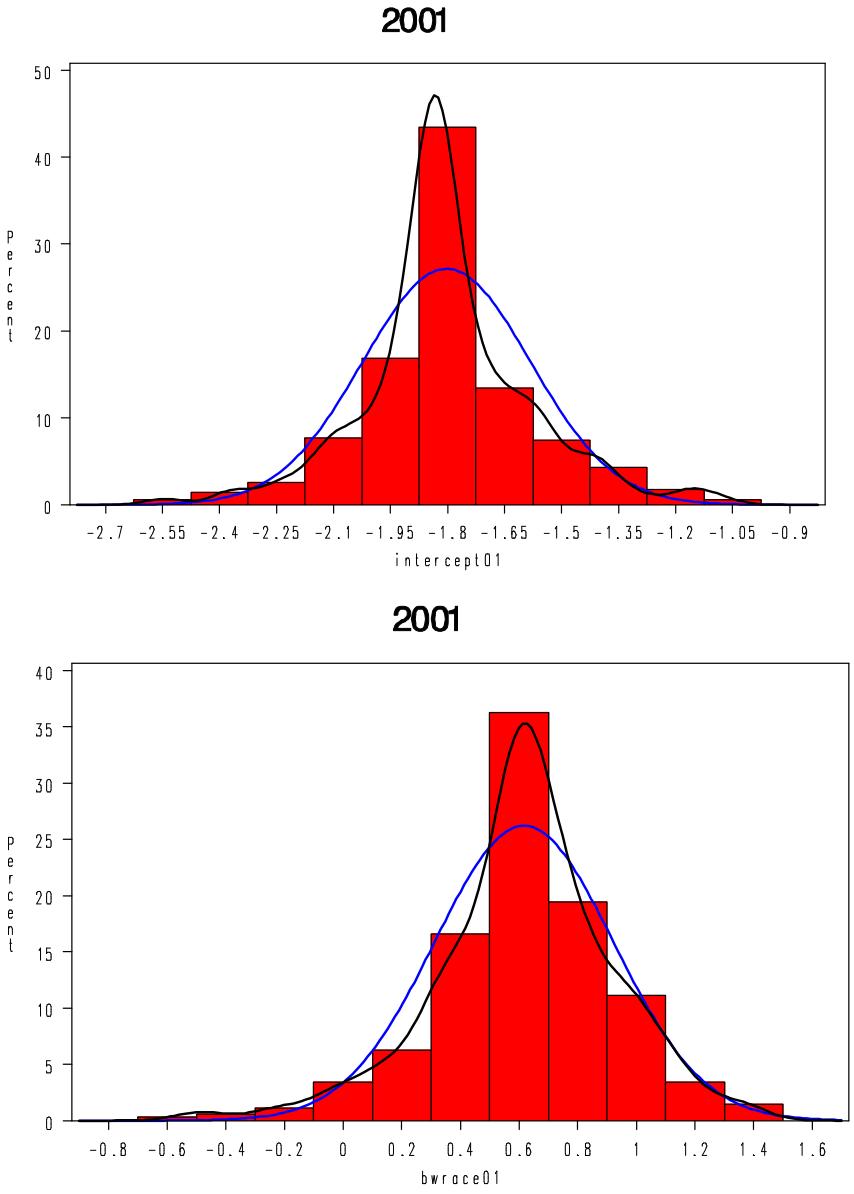
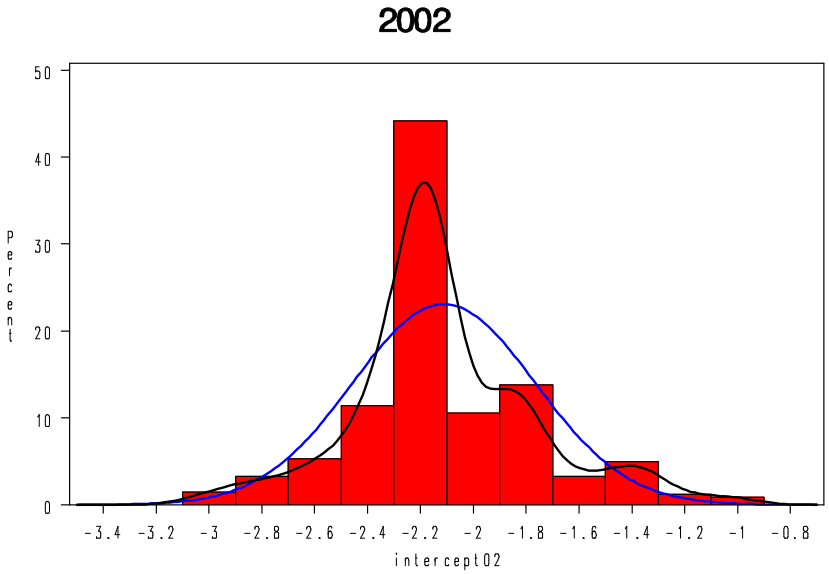


Figure A.10: Distributions of Random Intercepts and Random Effects for race for each census tract for the Multilevel Logistic Regression Model, HMDA 2002



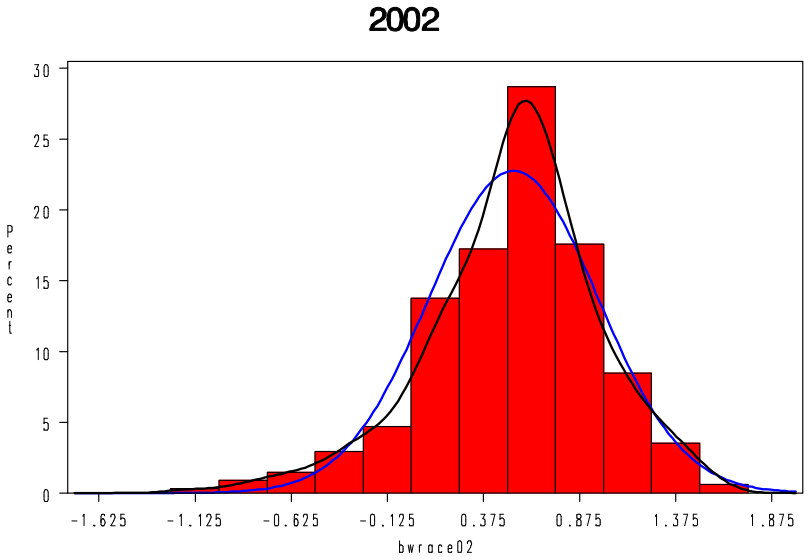


Figure A.11: Distributions of Random Intercepts and Random Effects for race for each census tract for the Multilevel Logistic Regression Model, HMDA 2003

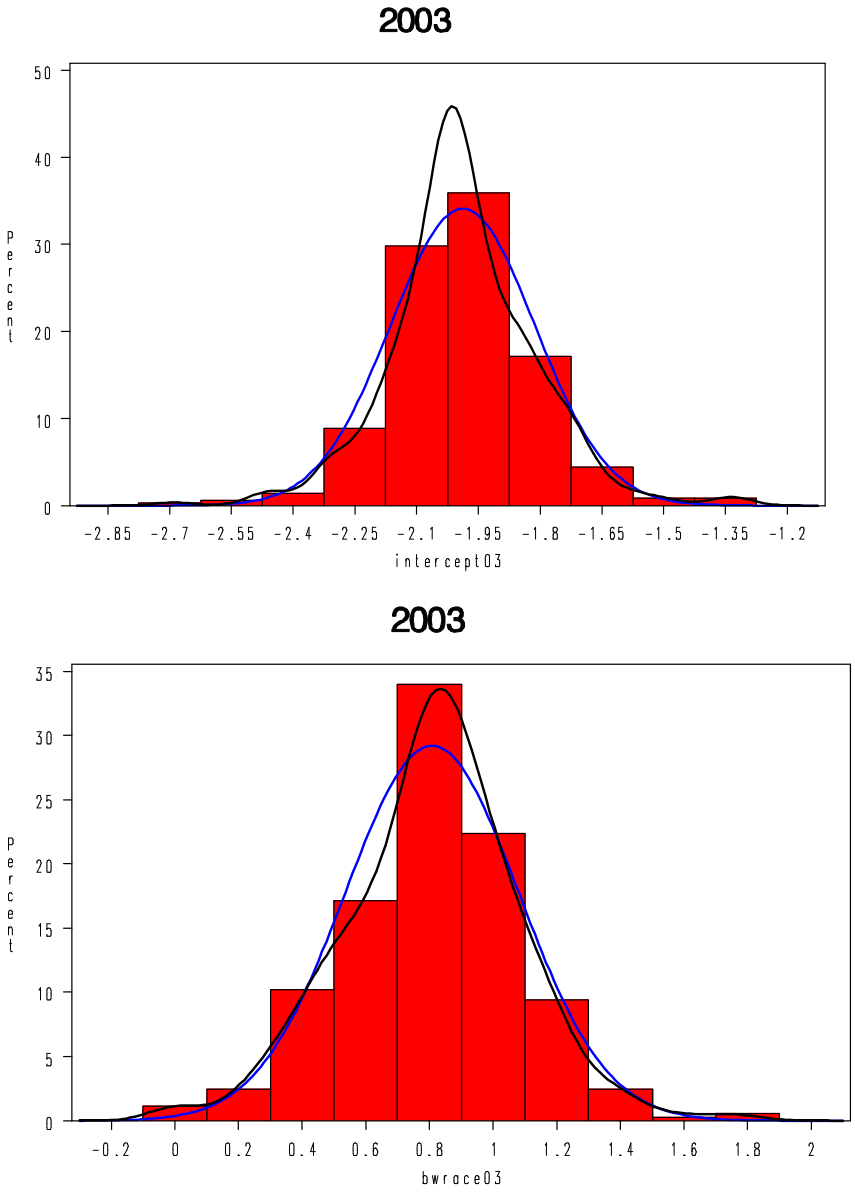


Figure A.12: Distributions of Random Intercepts and Random Effects for race for each census tract for the Multilevel Logistic Regression Model, HMDA 2004

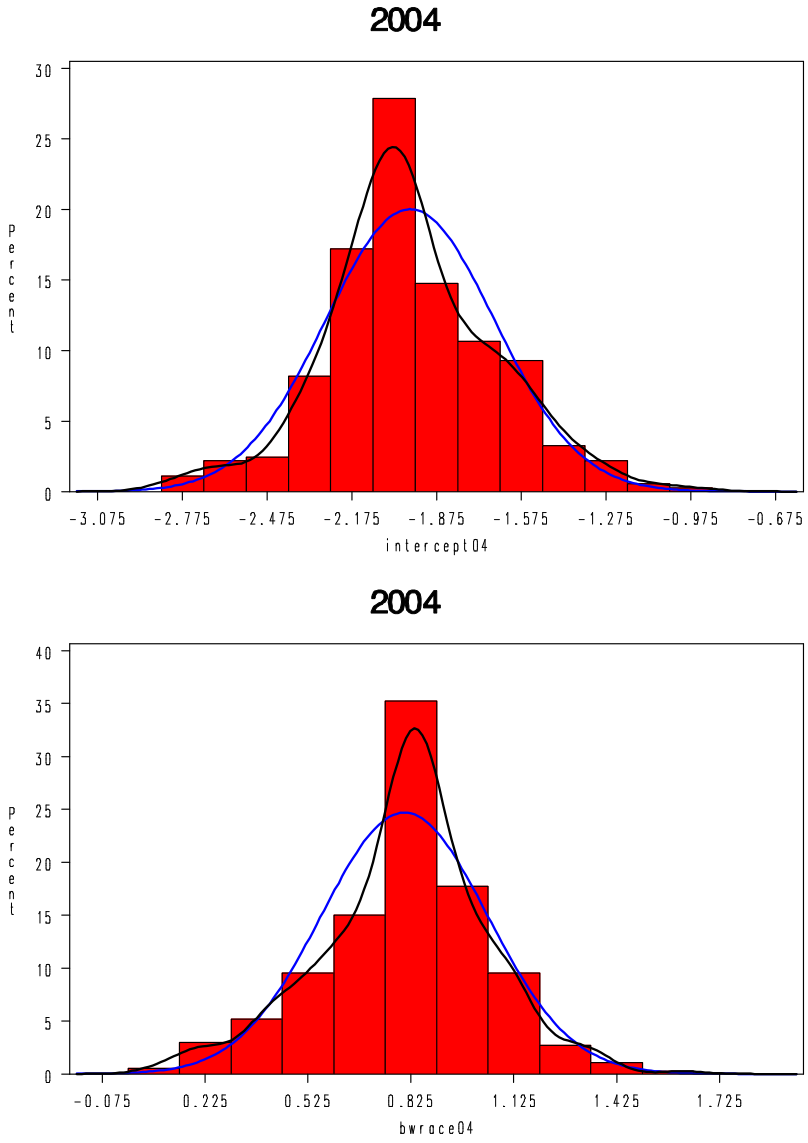
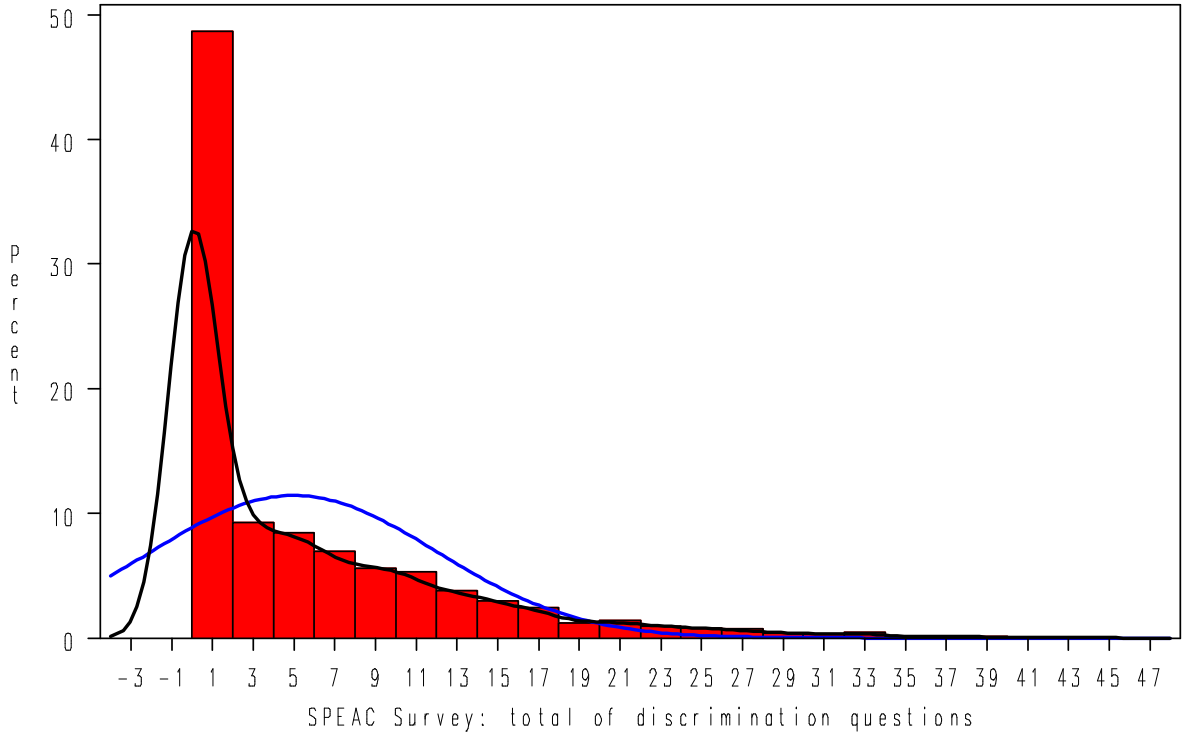
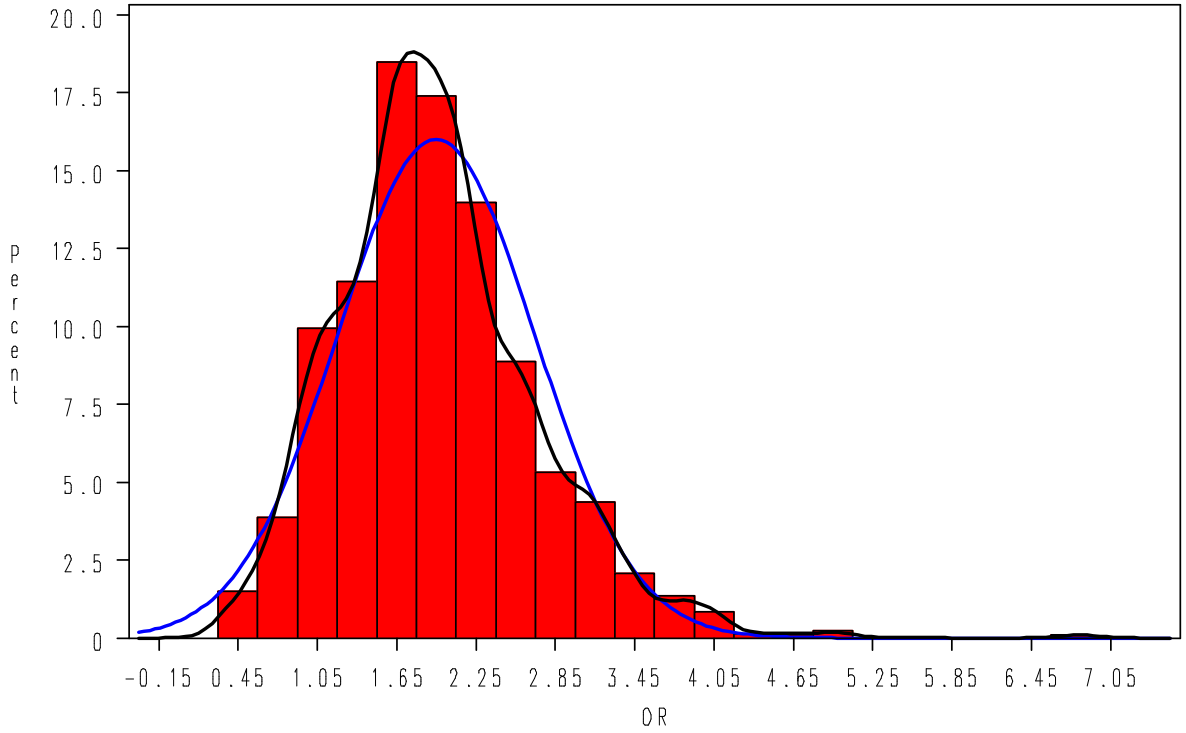


Figure A.13: Distribution of Perceived Discrimination Scores, SPEAC 1999-2004



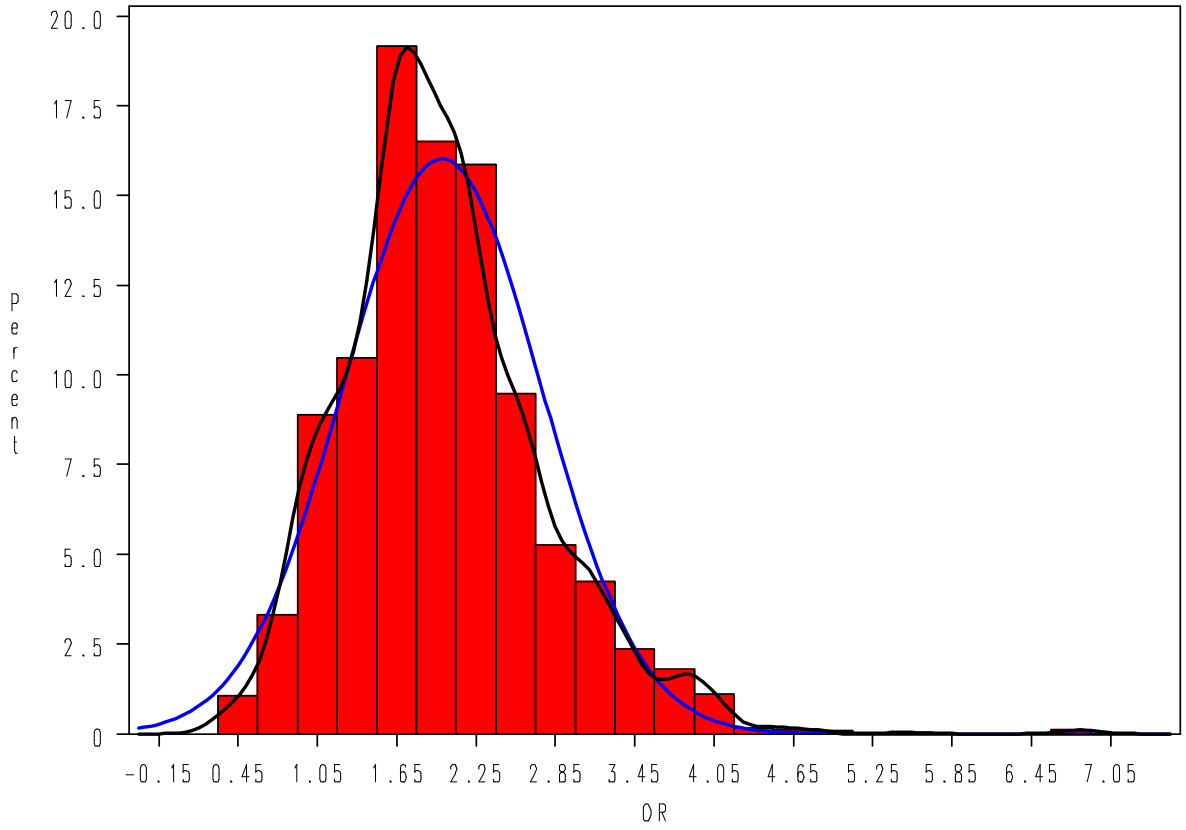
N	#Missing	Min	Max	Mean	Median	Mode	Std. Dev.	Range	Skew	Kurt
3934	15	0	43	5.0	2.0	0	6.98	43	1.77	3.24

Figure A.14: Distribution of Residential Redlining Index Scores, Odds Ratios, SPEAC 1999-2004



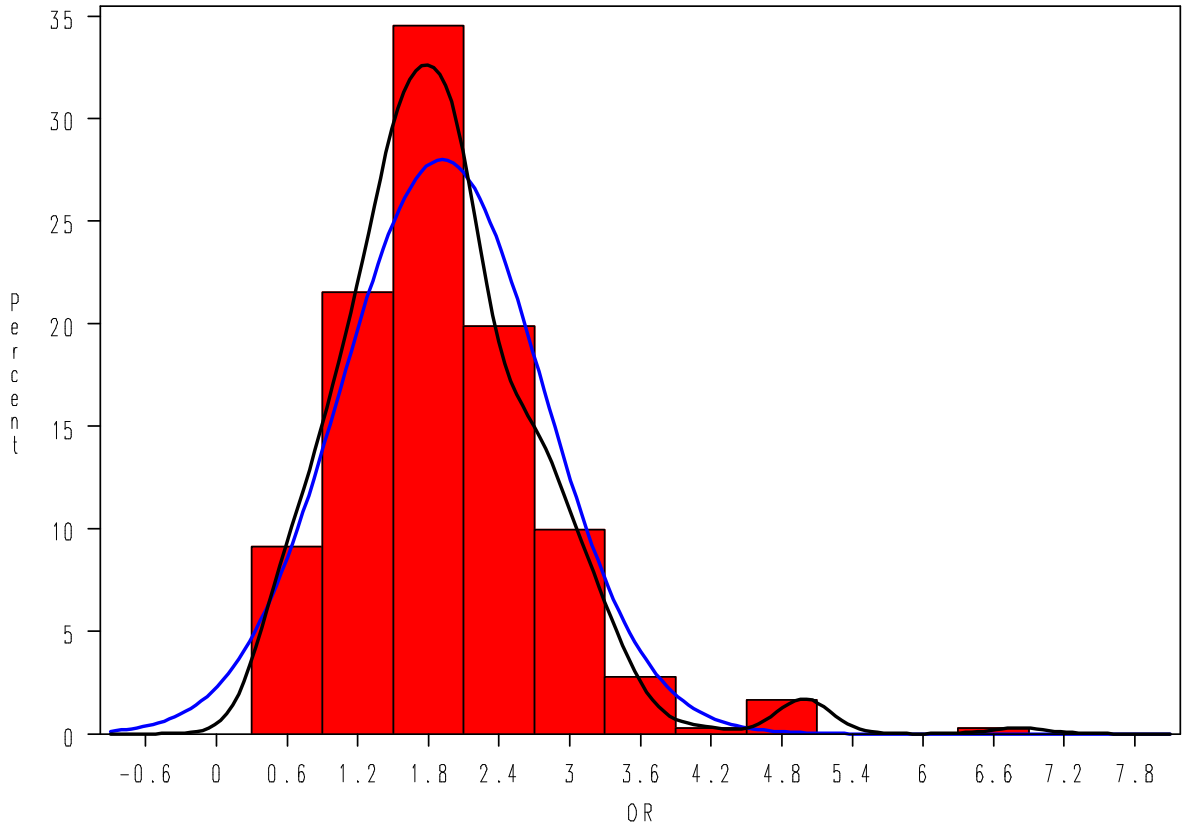
N	#Missing	Min	Max	Mean	Median	Mode	Std. Dev.	Range	Skew	Kurt
3903	46	0.3055	6.817	1.948	1.884	2.122	0.7485	6.51	0.8793	2.313

Figure A.15: Distribution of Residential Redlining Index Scores for Non-Hispanic Black Women Only, Odds Ratios, SPEAC 1999-2004



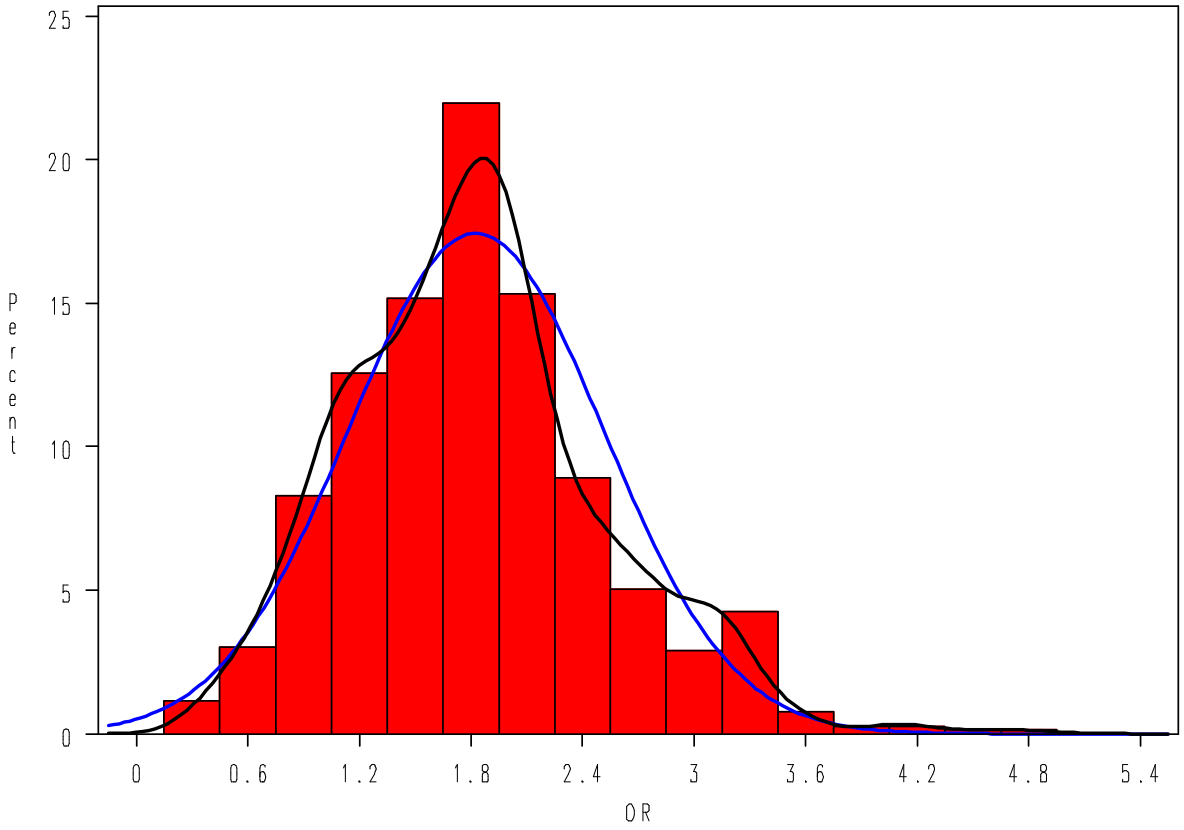
N	#Missing	Min	Max	Mean	Median	Mode	Std. Dev.	Range	Skew	Kurt
2624	37	0.3055	6.817	1.99	1.91	2.12	0.747	6.51	0.878	2.28

Figure A.16: Distribution of Residential Redlining Index Scores for Non-Hispanic White Women Only, Odds Ratios, SPEAC 1999-2004



N	#Missing	Min	Max	Mean	Median	Mode	Std. Dev.	Range	Skew	Kurt
362	2	0.3866	6.817	1.916	1.8139	1.033	0.8546	6.43	1.295	4.148

Figure A.17: Distribution of Residential Redlining Index Scores for Hispanic Women Only, Odds Ratios, SPEAC 1999-2004



N	#Missing	Min	Max	Mean	Median	Mode	Std. Dev.	Range	Skew	Kurt
797	6	0.409	4.80	1.827	1.79	3.15	0.687	4.394	0.5699	0.612

APPENDIX B: CHAPTER 5

Figure B.1: Distribution of the Perceived Discrimination Scores (*May not need to repeat b/c in appendix for Ch 4)

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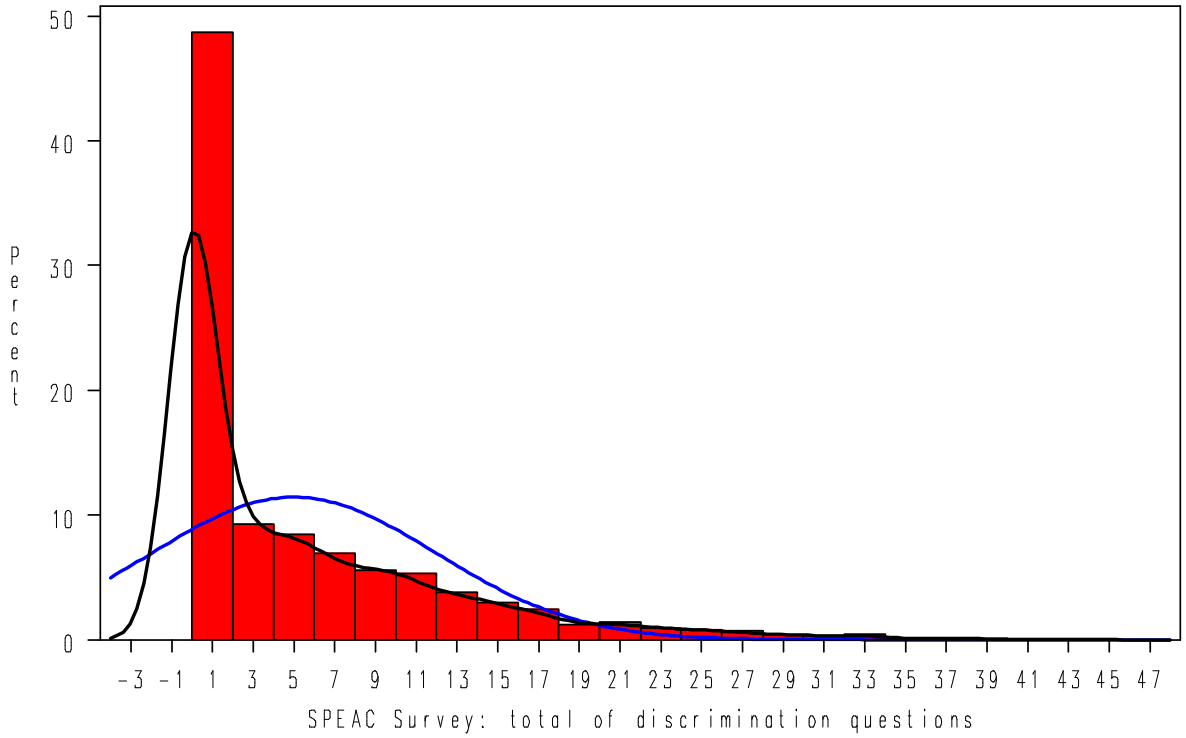
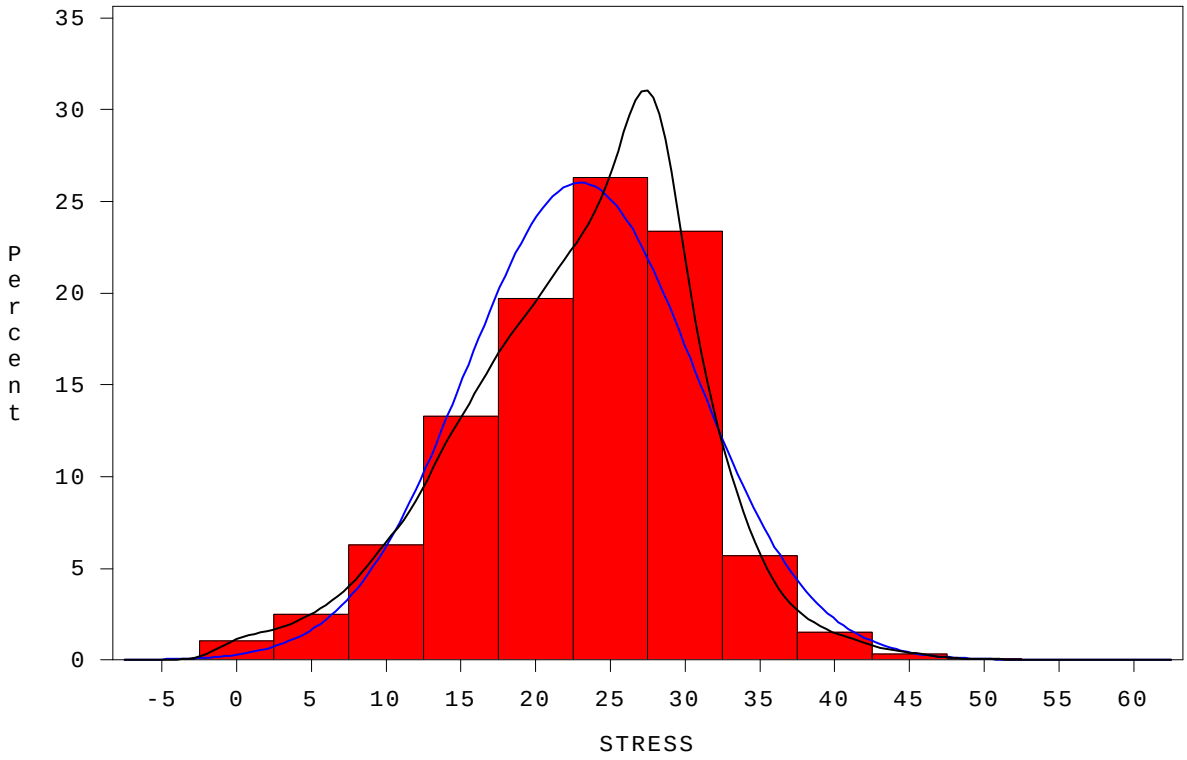


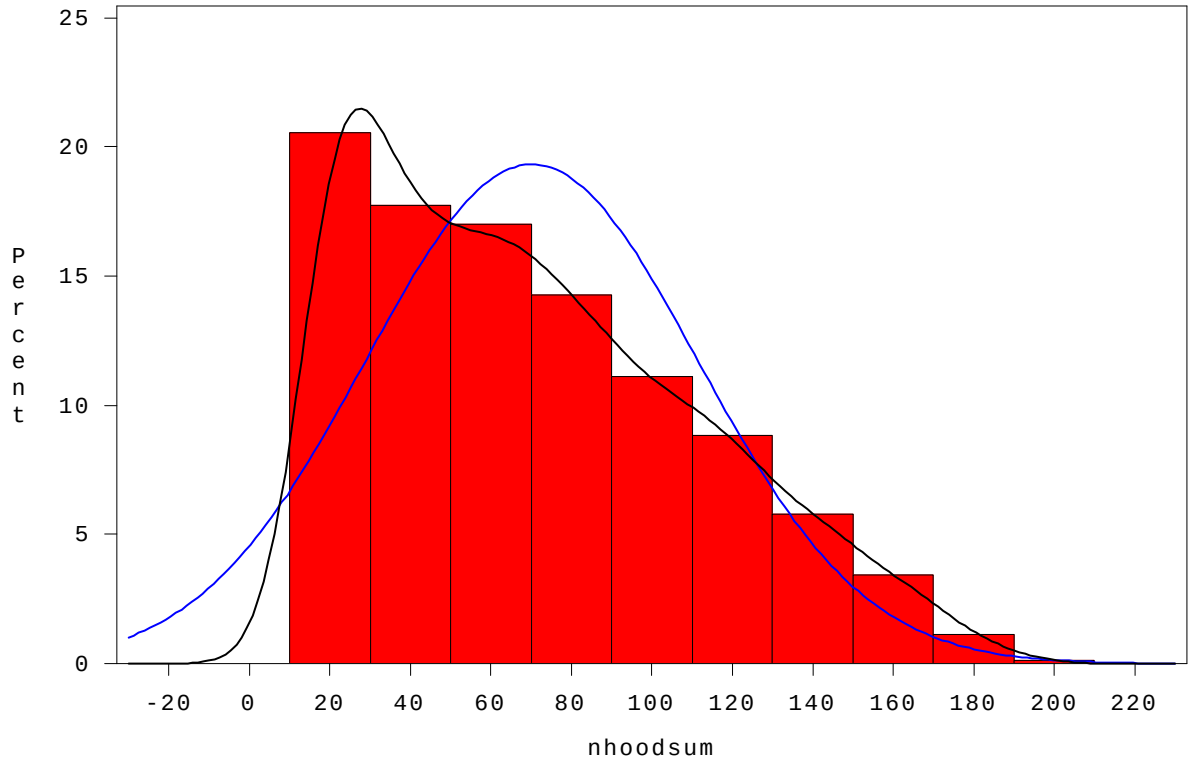
N	#Missing	Min	Max	Mean	Median	Mode	Std. Dev.	Range	Skew	Kurt
3934	**15**	**0**	**43**	**5.0**	**2.0**	**0**	**6.98**	**43**	**1.77**	**3.24**

Figure B.2: Distribution of the Cohen Perceived Stress Scale Scores



N	#Missing	Min	Max	Mean	Median	Mode	Std. Dev.	Range	Skew	Kurt
3937	12	0	51	22.99	24.0	28.0	7.67	51	-0.398	0.223

Figure B.3: Distribution of the Neighborhood Quality Scores



N	#Missing	Min	Max	Mean	Median	Mode	Std. Dev.	Range	Skew	Kurt
3942	7	17	190	70.17	63.0	19.0	41.28	173	0.624	-0.503

Table B.1: Estimates for the Proportional Odds Model for All Women Predicting Perceived Discrimination

Analysis of Maximum Likelihood Estimates							
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**	**Label**
Intercept	**High**	1	-2.7229	0.2492	119.4036	<.0001	Intercept: discrim3=High
Intercept	**Med**	1	-1.1841	0.2394	24.4582	<.0001	Intercept: discrim3=Med
Intercept	**Low**	1	0.5505	0.2386	5.3225	0.0211	Intercept: discrim3=Low
OR		1	-0.0505	0.0436	1.3405	0.2469	
AGE		1	-0.0100	0.00592	2.8587	0.0909	Age at interview
married	**Married/Cohabiting**	1	0.0863	0.0796	1.1732	0.2787	married Married/Cohabiting
EDUC	**GED/HS Grad**	1	-0.3420	0.0898	14.4976	0.0001	Education: no HS, GED or HS, Post HS GED/HS Grad
EDUC	**No High School**	1	-0.2197	0.0965	5.1806	0.0228	Education: no HS, GED or HS, Post HS No High School
income	**$10,000-14,999**	1	0.0162	0.1141	0.0202	0.8869	income $10,000-14,999
income	**$15,000-19,999**	1	-0.0919	0.1163	0.6235	0.4297	income $15,000-19,999
income	**$20,000-24,999**	1	-0.2355	0.1208	3.8021	0.0512	income $20,000-24,999
income	**$25,000-29,999**	1	-0.3894	0.1357	8.2285	0.0041	income $25,000-29,999
income	**$30,000-34,999**	1	-0.4602	0.1456	9.9864	0.0016	income $30,000-34,999
income	**$35,000-39,000**	1	-0.4162	0.1776	5.4950	0.0191	income $35,000-39,000
income	**$40,000+**	1	-0.6136	0.1423	18.5875	<.0001	income $40,000+
income	**$5,000-9,999**	1	-0.1224	0.1096	1.2487	0.2638	income $5,000-9,999
NEWRACE3	**Latina/Hispanic**	1	0.1111	0.1372	0.6551	0.4183	black, white, latino, and other—using NEWRACE2 and RACE Latina/Hispanic
NEWRACE3	**Non-Hispanic Black**	1	0.4357	0.1211	12.9442	0.0003	black, white, latino, and other—using NEWRACE2 and RACE Non-Hispanic Black
NEWRACE3	**Other**	1	0.5155	0.2206	5.4628	0.0194	black, white, latino, and other—using NEWRACE2 and RACE Other

Table B.2: Odds Ratios for the Proportional Odds Model for All Women Predicting Perceived Discrimination

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
OR	0.951	0.873	1.036
AGE	0.990	0.979	1.002
married Married/Cohabiting vs Not Married	1.090	0.933	1.274
EDUC GED/HS Grad vs Post HS	0.710	0.596	0.847
EDUC No High School vs Post HS	0.803	0.664	0.970
income $10,000-14,999 vs Under $5,000	1.016	0.813	1.271
income $15,000-19,999 vs Under $5,000	0.912	0.726	1.146
income $20,000-24,999 vs Under $5,000	0.790	0.624	1.001
income $25,000-29,999 vs Under $5,000	0.677	0.519	0.884
income $30,000-34,999 vs Under $5,000	0.631	0.474	0.840
income $35,000-39,000 vs Under $5,000	0.660	0.466	0.934
income $40,000+ vs Under $5,000	0.541	0.410	0.716
income $5,000-9,999 vs Under $5,000	0.885	0.714	1.097
NEWRACE3 Latina/Hispanic vs Non-Hispanic White	1.117	0.854	1.462
NEWRACE3 Non-Hispanic Black vs Non-Hispanic White	1.546	1.219	1.960
NEWRACE3 Other vs Non-Hispanic White	1.674	1.087	2.580

Table B.3: Estimates for the Proportional Odds Model for All Women Predicting Perceived Stress

Analysis of Maximum Likelihood Estimates							
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > Chi Sq**	**Label**
Intercept	**3**	1	-2.1458	0.3089	48.2654	<.0001	Intercept: stress3=3
Intercept	**2**	1	2.4273	0.3109	60.9556	<.0001	Intercept: stress3=2
OR		1	0.0296	0.0565	0.2750	0.6000	
AGE		1	0.0239	0.00759	9.9159	0.0016	Age at interview
married	**Married/Cohabiting**	1	-0.1124	0.1041	1.1666	0.2801	married Married/Cohabiting
EDUC	**GED/HS Grad**	1	-0.1982	0.1157	2.9360	0.0866	Education: no HS, GED or HS, Post HS GED/HS Grad
EDUC	**No High School**	1	-0.2288	0.1254	3.3275	0.0681	Education: no HS, GED or HS, Post HS No High School
income	**$10,000-14,999**	1	0.1188	0.1494	0.6322	0.4266	income $10,000-14,999
income	**$15,000-19,999**	1	-0.1976	0.1549	1.6278	0.2020	income $15,000-19,999
income	**$20,000-24,999**	1	-0.0111	0.1580	0.0049	0.9442	income $20,000-24,999
income	**$25,000-29,999**	1	0.1043	0.1742	0.3584	0.5494	income $25,000-29,999
income	**$30,000-34,999**	1	-0.1961	0.1906	1.0589	0.3035	income $30,000-34,999
income	**$35,000-39,000**	1	0.1804	0.2241	0.6481	0.4208	income $35,000-39,000
income	**$40,000+**	1	-0.2981	0.1849	2.6002	0.1068	income $40,000+
income	**$5,000-9,999**	1	0.0493	0.1442	0.1169	0.7325	income $5,000-9,999
NEWRACE3	**Latina/Hispanic**	1	-0.4658	0.1770	6.9266	0.0085	black, white, latino, and other--using NEWRACE2 and RACE Latina/Hispanic
NEWRACE3	**Non-Hispanic Black**	1	0.0424	0.1532	0.0767	0.7818	black, white, latino, and other--using NEWRACE2 and RACE Non-Hispanic Black
NEWRACE3	**Other**	1	-0.2261	0.2931	0.5949	0.4405	black, white, latino, and other--using NEWRACE2 and RACE Other

Table B.4: Odds Ratios for the Proportional Odds Model for All Women Predicting Perceived Stress

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
OR	1.030	0.922	1.151
AGE	1.024	1.009	1.040
married Married/Cohabiting vs Not Married	0.894	0.729	1.096
EDUC GED/HS Grad vs Post HS	0.820	0.654	1.029
EDUC No High School vs Post HS	0.795	0.622	1.017
income $10,000-14,999 vs Under $5,000	1.126	0.840	1.509
income $15,000-19,999 vs Under $5,000	0.821	0.606	1.112
income $20,000-24,999 vs Under $5,000	0.989	0.726	1.348
income $25,000-29,999 vs Under $5,000	1.110	0.789	1.562
income $30,000-34,999 vs Under $5,000	0.822	0.566	1.194
income $35,000-39,000 vs Under $5,000	1.198	0.772	1.858
income $40,000+ vs Under $5,000	0.742	0.517	1.066
income $5,000-9,999 vs Under $5,000	1.051	0.792	1.394
NEWRACE3 Latina/Hispanic vs Non-Hispanic White	0.628	0.444	0.888
NEWRACE3 Non-Hispanic Black vs Non-Hispanic White	1.043	0.773	1.409
NEWRACE3 Other vs Non-Hispanic White	0.798	0.449	1.417

Table B.5: Estimates for the Proportional Odds Model for All Women Predicting Neighborhood Quality

Analysis of Maximum Likelihood Estimates							
Parameter		**DF**	**Esti-mate**	**Stan-dard Error**	**Wald Chi-Square**	**Pr > Chi Sq**	**Label**
Intercept	**10**	1	-5.6561	0.3458	267.5187	<.0001	Intercept: nhood2=10
Intercept	**9**	1	-3.7464	0.2429	237.8276	<.0001	Intercept: nhood2=9
Intercept	**8**	1	-2.7757	0.2291	146.7298	<.0001	Intercept: nhood2=8
Intercept	**7**	1	-2.0043	0.2245	79.6778	<.0001	Intercept: nhood2=7
Intercept	**6**	1	-1.3376	0.2227	36.0754	<.0001	Intercept: nhood2=6
Intercept	**5**	1	-0.7411	0.2220	11.1478	0.0008	Intercept: nhood2=5
Intercept	**4**	1	-0.1113	0.2217	0.2521	0.6156	Intercept: nhood2=4
Intercept	**3**	1	0.5771	0.2219	6.7657	0.0093	Intercept: nhood2=3
Intercept	**2**	1	1.4693	0.2230	43.3978	<.0001	Intercept: nhood2=2
OR		1	0.1201	0.0405	8.8160	0.0030	
AGE		1	-0.0290	0.00553	27.4965	<.0001	Age at interview
married	**Married/Coha-biting**	1	-0.1464	0.0741	3.9011	0.0483	married Married/Cohabiting
EDUC	**GED/HS Grad**	1	0.2292	0.0842	7.4055	0.0065	Education: no HS, GED or HS, Post HS GED/HS Grad
EDUC	**No High School**	1	0.5163	0.0908	32.3036	<.0001	Education: no HS, GED or HS, Post HS No High School
income	**$10,000-14,999**	1	-0.2483	0.1070	5.3830	0.0203	income $10,000-14,999
income	**$15,000-19,999**	1	-0.5994	0.1094	30.0067	<.0001	income $15,000-19,999
income	**$20,000-24,999**	1	-0.5279	0.1127	21.9292	<.0001	income $20,000-24,999
income	**$25,000-29,999**	1	-0.5700	0.1258	20.5194	<.0001	income $25,000-29,999
income	**$30,000-34,999**	1	-0.7605	0.1348	31.8213	<.0001	income $30,000-34,999
income	**$35,000-39,000**	1	-0.4866	0.1637	8.8403	0.0029	income $35,000-39,000
income	**$40,000+**	1	-0.8562	0.1307	42.8924	<.0001	income $40,000+
income	**$5,000-9,999**	1	-0.2005	0.1021	3.8524	0.0497	income $5,000-9,999
NEW-RACE3	**Latina/Hispanic**	1	0.4282	0.1258	11.5882	0.0007	black, white, latino, and other--using NEWRACE2 and RACE Latina/Hispanic

Analysis of Maximum Likelihood Estimates							
Parameter		**DF**	**Esti-mate**	**Stan-dard Error**	**Wald Chi-Square**	**Pr > Chi Sq**	**Label**
NEW-RACE3	**Non-Hispanic Black**	1	0.7848	0.1111	49.8767	<.0001	black, white, latino, and other--using NEWRACE2 and RACE Non-Hispanic Black
NEW-RACE3	**Other**	1	0.0325	0.2089	0.0242	0.8764	black, white, latino, and other--using NEWRACE2 and RACE Other

Table B.6: Odds Ratios for the Proportional Odds Model for All Women Predicting Neighborhood Quality

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
OR	1.128	1.042	1.221
AGE	0.971	0.961	0.982
married Married/Cohabiting vs Not Married	0.864	0.747	0.999
EDUC GED/HS Grad vs Post HS	1.258	1.066	1.483
EDUC No High School vs Post HS	1.676	1.402	2.002
income $10,000-14,999 vs Under $5,000	0.780	0.632	0.962
income $15,000-19,999 vs Under $5,000	0.549	0.443	0.680
income $20,000-24,999 vs Under $5,000	0.590	0.473	0.736
income $25,000-29,999 vs Under $5,000	0.566	0.442	0.724
income $30,000-34,999 vs Under $5,000	0.467	0.359	0.609
income $35,000-39,000 vs Under $5,000	0.615	0.446	0.847
income $40,000+ vs Under $5,000	0.425	0.329	0.549
income $5,000-9,999 vs Under $5,000	0.818	0.670	1.000
NEWRACE3 Latina/Hispanic vs Non-Hispanic White	1.534	1.199	1.963
NEWRACE3 Non-Hispanic Black vs Non-Hispanic White	2.192	1.763	2.725
NEWRACE3 Other vs Non-Hispanic White	1.033	0.686	1.556

Table B.7: Estimates for the Proportional Odds Model for Black Women Predicting Perceived Discrimination

Analysis of Maximum Likelihood Estimates						
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept	**High**	1	-2.4373	0.2628	85.9931	<.0001
Intercept	**Med**	1	-0.9601	0.2511	14.6176	0.0001
Intercept	**Low**	1	0.7919	0.2506	9.9832	0.0016
OR		1	-0.0160	0.0523	0.0939	0.7593
AGE		1	-0.00042	0.00701	0.0036	0.9522
married	**Married/Cohabiting**	1	0.2608	0.1077	5.8682	0.0154
EDUC	**GED/HS Grad**	1	-0.4177	0.1071	15.2019	<.0001
EDUC	**No High School**	1	-0.1825	0.1180	2.3951	0.1217
income	**$10,000-14,999**	1	-0.1270	0.1424	0.7947	0.3727
income	**$15,000-19,999**	1	-0.2855	0.1459	3.8280	0.0504
income	**$20,000-24,999**	1	-0.4632	0.1467	9.9772	0.0016
income	**$25,000-29,999**	1	-0.5454	0.1625	11.2578	0.0008
income	**$30,000-34,999**	1	-0.5698	0.1733	10.8042	0.0010
income	**$35,000-39,000**	1	-0.5650	0.2051	7.5859	0.0059
income	**$40,000+**	1	-0.6616	0.1692	15.2850	<.0001
income	**$5,000-9,999**	1	-0.1607	0.1392	1.3336	0.2482

Table B.8: Odds Ratios for the Proportional Odds Model for Black Women Predicting Perceived Discrimination

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
OR	0.984	0.888	1.090
AGE	1.000	0.986	1.013
married Married/Cohabiting vs Not Married	1.298	1.051	1.603
EDUC GED/HS Grad vs Post HS	0.659	0.534	0.812
EDUC No High School vs Post HS	0.833	0.661	1.050
income $10,000-14,999 vs Under $5,000	0.881	0.666	1.164
income $15,000-19,999 vs Under $5,000	0.752	0.565	1.001
income $20,000-24,999 vs Under $5,000	0.629	0.472	0.839
income $25,000-29,999 vs Under $5,000	0.580	0.421	0.797
income $30,000-34,999 vs Under $5,000	0.566	0.403	0.795
income $35,000-39,000 vs Under $5,000	0.568	0.380	0.850
income $40,000+ vs Under $5,000	0.516	0.370	0.719
income $5,000-9,999 vs Under $5,000	0.852	0.648	1.119

Table B.9: Estimates for the Proportional Odds Model for Black Women Predicting Perceived Stress

Analysis of Maximum Likelihood Estimates						
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept	**3**	1	-2.2954	0.3217	50.9223	<.0001
Intercept	**2**	1	2.2290	0.3234	47.5133	<.0001
OR		1	0.0568	0.0669	0.7216	0.3956
AGE		1	0.0311	0.00882	12.3941	0.0004
married	**Married/Cohabiting**	1	-0.0528	0.1382	0.1459	0.7025
EDUC	**GED/HS Grad**	1	-0.1247	0.1367	0.8322	0.3616
EDUC	**No High School**	1	-0.1401	0.1518	0.8518	0.3560
income	**$10,000-14,999**	1	-0.0841	0.1839	0.2094	0.6473
income	**$15,000-19,999**	1	-0.2705	0.1901	2.0235	0.1549
income	**$20,000-24,999**	1	-0.0515	0.1871	0.0759	0.7829
income	**$25,000-29,999**	1	-0.0325	0.2055	0.0251	0.8742
income	**$30,000-34,999**	1	-0.2816	0.2243	1.5763	0.2093
income	**$35,000-39,000**	1	0.1062	0.2553	0.1730	0.6775
income	**$40,000+**	1	-0.5766	0.2219	6.7542	0.0094
income	**$5,000-9,999**	1	-0.0305	0.1796	0.0289	0.8650

Table B.10: Odds Ratios for the Proportional Odds Model for Black Women Predicting Perceived Stress

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
OR	1.058	0.928	1.207
AGE	1.032	1.014	1.050
married Married/Cohabiting vs Not Married	0.949	0.724	1.244
EDUC GED/HS Grad vs Post HS	0.883	0.675	1.154
EDUC No High School vs Post HS	0.869	0.646	1.171
income $10,000-14,999 vs Under $5,000	0.919	0.641	1.318
income $15,000-19,999 vs Under $5,000	0.763	0.526	1.108
income $20,000-24,999 vs Under $5,000	0.950	0.658	1.370
income $25,000-29,999 vs Under $5,000	0.968	0.647	1.448
income $30,000-34,999 vs Under $5,000	0.755	0.486	1.171
income $35,000-39,000 vs Under $5,000	1.112	0.674	1.834
income $40,000+ vs Under $5,000	0.562	0.364	0.868
income $5,000-9,999 vs Under $5,000	0.970	0.682	1.379

Table B.11: Estimates for the Proportional Odds Model for Black Women Predicting Neighborhood Quality

Analysis of Maximum Likelihood Estimates						
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept	**10**	1	-4.9069	0.3907	157.7433	<.0001
Intercept	**9**	1	-3.0723	0.2633	136.1796	<.0001
Intercept	**8**	1	-2.0020	0.2430	67.8755	<.0001
Intercept	**7**	1	-1.2200	0.2373	26.4241	<.0001
Intercept	**6**	1	-0.5134	0.2354	4.7561	0.0292
Intercept	**5**	1	0.0994	0.2351	0.1787	0.6725
Intercept	**4**	1	0.7070	0.2355	9.0108	0.0027
Intercept	**3**	1	1.4352	0.2368	36.7209	<.0001
Intercept	**2**	1	2.3211	0.2398	93.6950	<.0001
OR		1	0.1317	0.0489	7.2626	0.0070
AGE		1	-0.0324	0.00659	24.2481	<.0001
married	**Married/Cohabiting**	1	-0.1213	0.1014	1.4319	0.2315
EDUC	**GED/HS Grad**	1	0.2820	0.1007	7.8410	0.0051
EDUC	**No High School**	1	0.6693	0.1118	35.8483	<.0001
income	**$10,000-14,999**	1	-0.2949	0.1344	4.8137	0.0282
income	**$15,000-19,999**	1	-0.6807	0.1378	24.3864	<.0001
income	**$20,000-24,999**	1	-0.6507	0.1373	22.4478	<.0001
income	**$25,000-29,999**	1	-0.6927	0.1514	20.9308	<.0001
income	**$30,000-34,999**	1	-0.8065	0.1614	24.9721	<.0001
income	**$35,000-39,000**	1	-0.5684	0.1903	8.9244	0.0028
income	**$40,000+**	1	-0.9352	0.1577	35.1837	<.0001
income	**$5,000-9,999**	1	-0.2676	0.1312	4.1614	0.0414

Table B.12: Odds Ratios for the Proportional Odds Model for Black Women Predicting Neighborhood Quality

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
OR	1.141	1.037	1.255
AGE	0.968	0.956	0.981
married Married/Cohabiting vs Not Married	0.886	0.726	1.080
EDUC GED/HS Grad vs Post HS	1.326	1.088	1.615
EDUC No High School vs Post HS	1.953	1.569	2.431
income $10,000-14,999 vs Under $5,000	0.745	0.572	0.969
income $15,000-19,999 vs Under $5,000	0.506	0.386	0.663
income $20,000-24,999 vs Under $5,000	0.522	0.399	0.683
income $25,000-29,999 vs Under $5,000	0.500	0.372	0.673
income $30,000-34,999 vs Under $5,000	0.446	0.325	0.612
income $35,000-39,000 vs Under $5,000	0.566	0.390	0.822
income $40,000+ vs Under $5,000	0.393	0.288	0.535
income $5,000-9,999 vs Under $5,000	0.765	0.592	0.990

Table B.13: Estimates for the Proportional Odds Model for White Women Predicting Perceived Discrimination

Analysis of Maximum Likelihood Estimates						
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept	**High**	1	-0.2662	0.8905	0.0893	0.7650
Intercept	**Med**	1	1.4774	0.8423	3.0764	0.0794
Intercept	**Low**	1	3.3262	0.8580	15.0286	0.0001
OR		1	-0.5248	0.1661	9.9837	0.0016
AGE		1	-0.0802	0.0242	10.9816	0.0009
married	**Married/Cohabiting**	1	-0.4064	0.2796	2.1120	0.1461
EDUC	**GED/HS Grad**	1	0.2944	0.3655	0.6490	0.4205
EDUC	**No High School**	1	-0.3153	0.3864	0.6660	0.4145
income	**$10,000-14,999**	1	0.0764	0.4647	0.0271	0.8694
income	**$15,000-19,999**	1	-0.6600	0.4716	1.9587	0.1617
income	**$20,000-24,999**	1	-0.0724	0.4574	0.0250	0.8743
income	**$25,000-29,999**	1	-0.6869	0.5613	1.4980	0.2210
income	**$30,000-34,999**	1	-0.5749	0.5523	1.0836	0.2979
income	**$35,000-39,000**	1	-0.9134	0.6220	2.1569	0.1419
income	**$40,000+**	1	-1.6958	0.4954	11.7161	0.0006
income	**$5,000-9,999**	1	-0.6646	0.5171	1.6519	0.1987

Table B.14: Odds Ratios for the Proportional Odds Model for White Women Predicting Perceived Discrimination

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
OR	0.592	0.427	0.819
AGE	0.923	0.880	0.968
married Married/Cohabiting vs Not Married	0.666	0.385	1.152
EDUC GED/HS Grad vs Post HS	1.342	0.656	2.747
EDUC No High School vs Post HS	0.730	0.342	1.556
income $10,000-14,999 vs Under $5,000	1.079	0.434	2.684
income $15,000-19,999 vs Under $5,000	0.517	0.205	1.302
income $20,000-24,999 vs Under $5,000	0.930	0.380	2.280
income $25,000-29,999 vs Under $5,000	0.503	0.167	1.511
income $30,000-34,999 vs Under $5,000	0.563	0.191	1.661
income $35,000-39,000 vs Under $5,000	0.401	0.119	1.357
income $40,000+ vs Under $5,000	0.183	0.069	0.484
income $5,000-9,999 vs Under $5,000	0.514	0.187	1.417

Table B.15: Estimates for the Partial Proportional Odds Model for White Women Predicting Perceived Stress

Analysis Of Parameter Estimates								
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald 95% Confidence Limits**		**Chi-Square**	**Pr > ChiSq**
Intercept		1	-0.3430	0.5080	-1.3386	0.6526	0.46	0.4995
OR		1	-0.0859	0.1026	-0.2870	0.1151	0.70	0.4022
AGE		1	-0.0330	0.0154	-0.0633	-0.0028	4.59	0.0321
married	Not Married	1	-0.0370	0.1841	-0.3978	0.3238	0.04	0.8407
married	Married/ Cohabiting	0	0.0000	0.0000	0.0000	0.0000	.	.
EDUC	Post HS	1	0.2394	0.2464	-0.2436	0.7224	0.94	0.3313
EDUC	GED/HS Grad	1	0.2249	0.1811	-0.1301	0.5799	1.54	0.2143
EDUC	No High School	0	0.0000	0.0000	0.0000	0.0000	.	.
income	$40,000+	1	-0.8919	0.3102	-1.4999	-0.2839	8.27	0.0040
income	$35,000-39,000	1	-0.4165	0.4009	-1.2022	0.3692	1.08	0.2988
income	$30,000-34,999	1	-0.9171	0.3880	-1.6775	-0.1567	5.59	0.0181
income	$25,000-29,999	1	-0.5608	0.3722	-1.2904	0.1687	2.27	0.1319
income	$20,000-24,999	1	-0.5536	0.3110	-1.1630	0.0559	3.17	0.0751
income	$15,000-19,999	1	-0.7770	0.3193	-1.4028	-0.1511	5.92	0.0150
income	$10,000-14,999	1	-0.1602	0.3090	-0.7657	0.4454	0.27	0.6041
income	$5,000-9,999	1	-0.8752	0.3532	-1.5675	-0.1829	6.14	0.0132
income	Under $5,000	0	0.0000	0.0000	0.0000	0.0000	.	.
logtype	1	1	1.7175	0.2022	1.3212	2.1138	72.16	<.0001
logtype	2	1	0.5763	0.2136	0.1578	0.9949	7.28	0.0070
logtype	3	0	0.0000	0.0000	0.0000	0.0000	.	.
Scale		0	1.0000	0.0000	1.0000	1.0000		

Table B.16: Estimates for the Partial Proportional Odds Model for White Women Predicting Perceived Stress

Contrast Estimate Results							
Label	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Chi-Square**	**Pr > ChiSq**
Beta (Redlining)	-0.0859	0.1026	0.05	-0.2870	0.1151	0.70	0.4022
Exp(Beta (Redlining))	0.9176	0.0941	0.05	0.7505	1.1220		

Table B.17: Estimates for the Partial Proportional Odds Model for White Women Predicting Neighborhood Quality

Analysis Of Parameter Estimates								
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald 95% Confidence Limits**		**Chi-Square**	**Pr > ChiSq**
Intercept		1	-4.5630	1.0645	-6.6493	-2.4767	18.38	<.0001
OR		1	-0.4260	0.0800	-0.5827	-0.2693	28.39	<.0001
AGE		1	-0.0191	0.0113	-0.0414	0.0031	2.85	0.0916
married	Not Married	1	0.3493	0.1384	0.0780	0.6206	6.37	0.0116
married	Married/Cohabiting	0	0.0000	0.0000	0.0000	0.0000	.	.
EDUC	Post HS	1	0.1616	0.1821	-0.1953	0.5185	0.79	0.3749
EDUC	GED/HS Grad	1	-0.0743	0.1330	-0.3351	0.1864	0.31	0.5763
EDUC	No High School	0	0.0000	0.0000	0.0000	0.0000	.	.
income	$40,000+	1	-0.6588	0.2323	-1.1141	-0.2034	8.04	0.0046
income	$35,000-39,000	1	0.3807	0.2919	-0.1915	0.9529	1.70	0.1922
income	$30,000-34,999	1	0.0381	0.2731	-0.4971	0.5733	0.02	0.8889
income	$25,000-29,999	1	-0.1971	0.2775	-0.7411	0.3468	0.50	0.4775
income	$20,000-24,999	1	0.2487	0.2291	-0.2003	0.6977	1.18	0.2776
income	$15,000-19,999	1	-0.6374	0.2405	-1.1088	-0.1659	7.02	0.0081
income	$10,000-14,999	1	-0.2625	0.2376	-0.7282	0.2031	1.22	0.2692
income	$5,000-9,999	1	-0.6744	0.2634	-1.1907	-0.1582	6.56	0.0104
income	Under $5,000	0	0.0000	0.0000	0.0000	0.0000	.	.
logtype	1	1	11.6819	1.4189	8.9008	14.4629	67.78	<.0001
logtype	2	1	6.6185	1.0112	4.6365	8.6005	42.84	<.0001

Analysis Of Parameter Estimates								
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald 95% Confidence Limits**		**Chi-Square**	**Pr > ChiSq**
logtype	3	1	5.7113	1.0099	3.7319	7.6906	31.98	<.0001
logtype	4	1	5.0951	1.0105	3.1146	7.0756	25.42	<.0001
logtype	5	1	4.3330	1.0134	2.3467	6.3194	18.28	<.0001
logtype	6	1	3.4963	1.0216	1.4939	5.4987	11.71	0.0006
logtype	7	1	2.9677	1.0318	0.9454	4.9901	8.27	0.0040
logtype	8	1	2.3432	1.0531	0.2791	4.4072	4.95	0.0261
logtype	9	1	1.3997	1.1220	-0.7994	3.5989	1.56	0.2122
logtype	10	0	0.0000	0.0000	0.0000	0.0000	.	.
Scale		0	1.0000	0.0000	1.0000	1.0000		

Table B.18: Odds Ratio for the Partial Proportional Odds Model for White Women Predicting Neighborhood Quality

Contrast Estimate Results							
Label	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Chi-Square**	**Pr > ChiSq**
Beta (Redlining)	-0.4260	0.0800	0.05	-0.5827	-0.2693	28.39	<.0001
Exp(Beta (Redlining))	0.6531	0.0522	0.05	0.5584	0.7639		

Table B.19: Estimates for the Proportional Odds Model for Latinas Predicting Perceived Discrimination

Analysis of Maximum Likelihood Estimates						
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept	**High**	1	-2.3887	0.5161	21.4177	<.0001
Intercept	**Med**	1	-0.6805	0.4850	1.9687	0.1606
Intercept	**Low**	1	1.0552	0.4848	4.7366	0.0295
OR		1	0.0316	0.1032	0.0936	0.7596
AGE		1	-0.0301	0.0143	4.4087	0.0358
married	**Married/Cohabiting**	1	-0.1899	0.1435	1.7520	0.1856
EDUC	**GED/HS Grad**	1	-0.4083	0.2155	3.5884	0.0582
EDUC	**No High School**	1	-0.3460	0.2138	2.6175	0.1057
income	**$10,000-14,999**	1	0.1276	0.2393	0.2842	0.5939
income	**$15,000-19,999**	1	0.3302	0.2340	1.9917	0.1582
income	**$20,000-24,999**	1	0.1702	0.2951	0.3327	0.5641
income	**$25,000-29,999**	1	-0.0513	0.3213	0.0255	0.8732
income	**$30,000-34,999**	1	-0.3639	0.3724	0.9549	0.3285
income	**$35,000-39,000**	1	-0.4745	0.5517	0.7398	0.3897
income	**$40,000+**	1	0.1047	0.4252	0.0607	0.8054
income	**$5,000-9,999**	1	-0.0705	0.2038	0.1196	0.7295

Table B.20: Odds Ratios for the Proportional Odds Model for Latinas Predicting Perceived Discrimination

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
OR	1.032	0.843	1.264
AGE	0.970	0.944	0.998
married Married/Cohabiting vs Not Married	0.827	0.624	1.096
EDUC GED/HS Grad vs Post HS	0.665	0.436	1.014
EDUC No High School vs Post HS	0.708	0.465	1.076
income $10,000-14,999 vs Under $5,000	1.136	0.711	1.816
income $15,000-19,999 vs Under $5,000	1.391	0.880	2.201
income $20,000-24,999 vs Under $5,000	1.186	0.665	2.114
income $25,000-29,999 vs Under $5,000	0.950	0.506	1.783
income $30,000-34,999 vs Under $5,000	0.695	0.335	1.442
income $35,000-39,000 vs Under $5,000	0.622	0.211	1.835
income $40,000+ vs Under $5,000	1.110	0.483	2.555
income $5,000-9,999 vs Under $5,000	0.932	0.625	1.389

Table B.21: Estimates for the Proportional Odds Model for Latinas Predicting Perceived Stress

Analysis of Maximum Likelihood Estimates						
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept	**3**	1	-2.3656	0.6816	12.0441	0.0005
Intercept	**2**	1	2.6627	0.6840	15.1534	<.0001
OR		1	-0.0975	0.1460	0.4455	0.5045
AGE		1	0.0145	0.0198	0.5396	0.4626
married	**Married/Cohabiting**	1	-0.0507	0.2019	0.0630	0.8019
EDUC	**GED/HS Grad**	1	-0.5643	0.3024	3.4827	0.0620
EDUC	**No High School**	1	-0.4185	0.3009	1.9348	0.1642
income	**$10,000-14,999**	1	1.1020	0.3279	11.2939	0.0008
income	**$15,000-19,999**	1	-0.1526	0.3415	0.1998	0.6549
income	**$20,000-24,999**	1	-0.6322	0.4074	2.4079	0.1207
income	**$25,000-29,999**	1	0.5183	0.4540	1.3033	0.2536
income	**$30,000-34,999**	1	-0.0201	0.5191	0.0015	0.9691
income	**$35,000-39,000**	1	0.6294	0.7459	0.7121	0.3987
income	**$40,000+**	1	0.8778	0.5747	2.3328	0.1267
income	**$5,000-9,999**	1	0.1789	0.2933	0.3719	0.5420

Table B.22: Odds Ratios for the Proportional Odds Model for Latinas Predicting Perceived Stress

Odds Ratio Estimates			
Effect	**Point Estimate**	**95% Wald Confidence Limits**	
OR	0.907	0.681	1.208
AGE	1.015	0.976	1.055
married Married/Cohabiting vs Not Married	0.951	0.640	1.412
EDUC GED/HS Grad vs Post HS	0.569	0.314	1.029
EDUC No High School vs Post HS	0.658	0.365	1.187
income $10,000-14,999 vs Under $5,000	3.010	1.583	5.724
income $15,000-19,999 vs Under $5,000	0.858	0.440	1.676
income $20,000-24,999 vs Under $5,000	0.531	0.239	1.181
income $25,000-29,999 vs Under $5,000	1.679	0.690	4.089
income $30,000-34,999 vs Under $5,000	0.980	0.354	2.711
income $35,000-39,000 vs Under $5,000	1.877	0.435	8.096
income $40,000+ vs Under $5,000	2.406	0.780	7.420
income $5,000-9,999 vs Under $5,000	1.196	0.673	2.125

Table B.23: Estimates for the Partial Proportional Odds Model for Latinas Predicting Neighborhood Quality

Analysis Of Parameter Estimates								
Parameter		**DF**	**Estimate**	**Standard Error**	**Wald 95% Confidence Limits**		**Chi-Square**	**Pr > ChiSq**
Intercept		1	-5.4966	0.6107	-6.6937	-4.2996	81.00	<.0001
OR		1	0.3614	0.0493	0.2648	0.4581	53.72	<.0001
AGE		1	-0.0213	0.0068	-0.0346	-0.0081	9.96	0.0016
married	Not Married	1	0.1136	0.0681	-0.0198	0.2470	2.78	0.0952
married	Married/Coha-biting	0	0.0000	0.0000	0.0000	0.0000	.	.
EDUC	Post HS	1	-0.1831	0.1046	-0.3881	0.0219	3.06	0.0801
EDUC	GED/HS Grad	1	-0.0354	0.0761	-0.1845	0.1137	0.22	0.6419
EDUC	No High School	0	0.0000	0.0000	0.0000	0.0000	.	.
income	$40,000+	1	-0.2388	0.2042	-0.6391	0.1615	1.37	0.2423
income	$35,000-39,000	1	-0.9157	0.2661	-1.4373	-0.3941	11.84	0.0006
income	$30,000-34,999	1	-1.0728	0.1892	-1.4436	-0.7020	32.15	<.0001
income	$25,000-29,999	1	-0.2573	0.1533	-0.5577	0.0431	2.82	0.0932
income	$20,000-24,999	1	-0.8180	0.1479	-1.1079	-0.5280	30.58	<.0001
income	$15,000-19,999	1	-0.6026	0.1154	-0.8289	-0.3763	27.24	<.0001
income	$10,000-14,999	1	-0.1964	0.1127	-0.4173	0.0246	3.03	0.0816
income	$5,000-9,999	1	-0.1818	0.0946	-0.3673	0.0037	3.69	0.0548
income	Under $5,000	0	0.0000	0.0000	0.0000	0.0000	.	.
logtype	1	1	32.0365	19193.53	-37586.6	37650.66	0.00	0.9987
logtype	2	1	7.0015	0.5865	5.8520	8.1510	142.52	<.0001
logtype	3	1	6.0709	0.5841	4.9261	7.2157	108.04	<.0001
logtype	4	1	5.4700	0.5837	4.3259	6.6141	87.81	<.0001
logtype	5	1	4.7596	0.5844	3.6141	5.9050	66.33	<.0001
logtype	6	1	4.2438	0.5858	3.0956	5.3920	52.48	<.0001
logtype	7	1	3.6699	0.5888	2.5158	4.8240	38.84	<.0001
logtype	8	1	2.9116	0.5968	1.7418	4.0814	23.80	<.0001
logtype	9	1	2.1965	0.6124	0.9962	3.3967	12.87	0.0003
logtype	10	0	0.0000	0.0000	0.0000	0.0000	.	.
Scale		0	1.0000	0.0000	1.0000	1.0000		

Table B.24: Odds Ratios for the Partial Proportional Odds Model for Latinas Predicting Neighborhood Quality

Contrast Estimate Results							
Label	**Estimate**	**Standard Error**	**Alpha**	**Confidence Limits**		**Chi-Square**	**Pr > ChiSq**
Beta (Redlining)	0.3614	0.0493	0.05	0.2648	0.4581	53.72	<.0001
Exp(Beta (Redlining))	1.4354	0.0708	0.05	1.3031	1.5810		

APPENDIX C: CHAPTER 6

Table C.1: Fixed effects logistic regression models, change in race-preterm birth odds ratios and 95% confidence intervals after adjustment for community-level and individual stressors for, SPEAC 1999-2004

		OR (95% CI)	
Model	**Adjustment**	**Black vs. White women**	**Hispanic vs. White women**
1	**Unadjusted (Race/Ethnicity Only)**	**2.13 (1.40, 3.25)*****	**1.08 (0.67, 1.76)**
2	**Model 1 + Residential Redlining**	**2.15 (1.41, 3.27)*****	**1.04 (0.64, 1.69)**
3	**Model 1 + Residential Segregation**	**2.03 (1.32, 3.11)****	**1.00 (0.61, 1.65)**
4	**Model 1 + Percent Black in neighborhood**	**2.09 (1.31, 3.34)****	**1.08 (0.66, 1.75)**
5	**Model 1 + All neighborhood variables**	**2.00 (1.24, 3.21)****	**0.96 (0.58, 1.59)**
6	**Model 1 + Sociodemographic Factors**	**2.09 (1.32, 3.32)****	**1.02 (0.60, 1.73)**
7	**Model 6 + Individual risk factors**	**2.28 (1.41, 3.70)*****	**1.09 (0.62, 1.91)**
8	**Model 7 + Perception Scales (stress, discrimination, neighborhood quality)**	**2.38 (1.46, 3.89)*****	**1.13 (0.64, 1.99)**
9	**Model 7 + Residential Redlining**	**2.32 (1.43, 3.77)*****	**1.05 (0.60, 1.85)**
10	**Model 7 + All Perception Scale & neighborhood variables**	**2.25 (1.31, 3.86)****	**1.01 (0.57, 1.82)**

***p<0.05; **p<0.01; ***p<0.001**

(Sociodemographic factors include age, income, education and marital status; Individual risk factors include parity, alcohol and tobacco use)

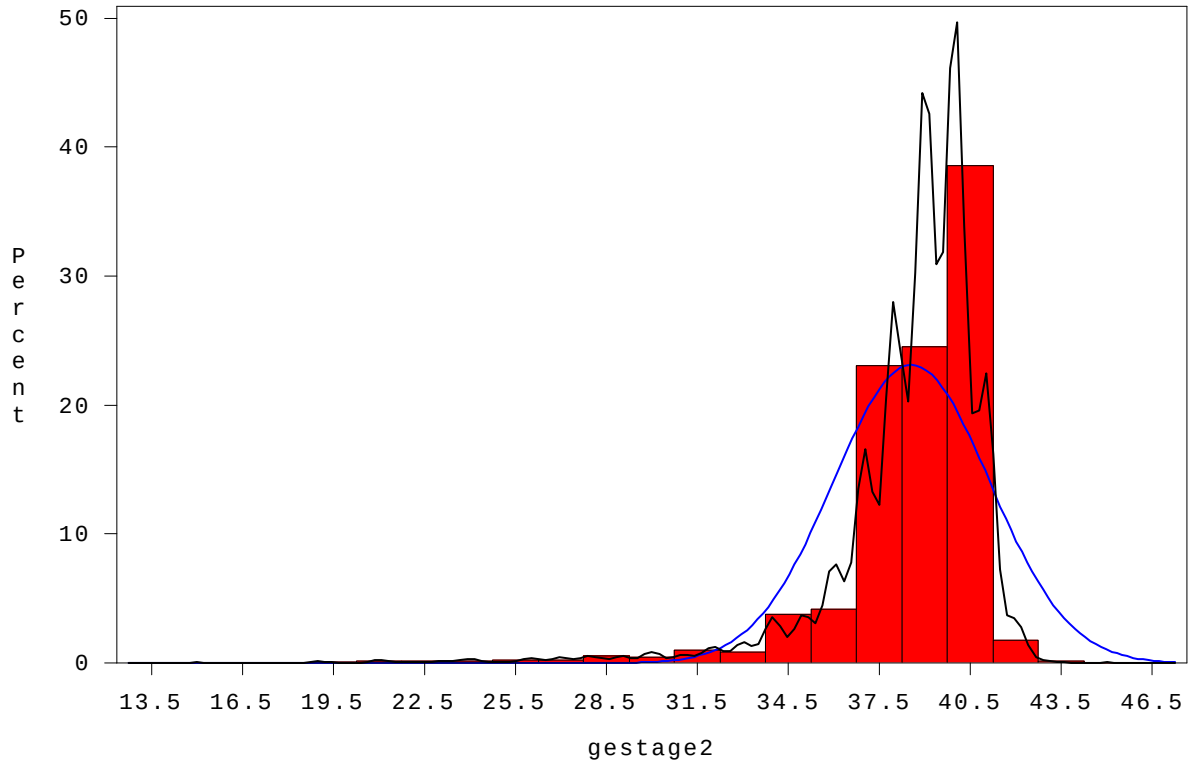
Table C.2: Coefficients and standard errors for fixed effects linear regression predicting gestational age for all women and by race/ethnicity, SPEAC 1999-2004

Characteristics	**All Women**				**Black Women Only**	**White Women Only**	**Hispanic Women Only**
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 4**	**Model 4**	**Model 4**
Intercept	38.96 (0.22)	39.85 (0.36)	40.08 (0.48)	39.61 (0.48)	39.16 (0.65)	42.97 (1.33)	38.50 (0.91)
Residential Redlining	0.021 (0.59)	-0.022 (0.063)	---	0.020 (0.065)	0.039 (0.085)	-0.23 (0.16)	0.077 (0.13)
Percentage Black	-0.098 (0.16)	-0.0039 (0.17)	---	-0.077 (0.17)	-0.065 (0.22)	-0.34 (0.56)	0.071 (0.38)
Residential Segregation	0.34 (0.34)	0.51 (0.36)	---	0.328 (0.38)	0.56 (0.53)	-0.57 (0.81)	-0.11 (0.68)
Perceived Everyday Discrimination	---	---	0.0006 (0.059)	0.0026 (0.059)	-0.085 (0.076)	0.32 (0.18)	0.13
Perceived Major Discrimination	---	---	-0.13 (0.10)	-0.14 (0.10)	-0.15 (0.13)	-0.51 (0.31)	-0.13 (0.20)
Perceived Stress	---	---	-0.017 (0.11)	-0.045 (0.106)	0.11 (0.14)	-0.98 (0.27)***	0.0053 (0.21)
Perceived Neighborhood Quality	---	---	0.031 (0.022)	0.037 (0.023)	0.027 (0.030)	0.049 (0.069)	0.023 (0.39)
Age	---	-0.31 (0.0083)***	-0.034 (0.01)***	-0.035 (0.01)***	-0.046 (0.013)***	-0.022 (0.027)	0.013 (0.019)
Marital Status (not married)							
Married/Cohabiting	---	0.029 (0.11)	-0.0058 (0.11)	-0.0099 (0.12)	-0.084 (0.17)	0.34 (0.28)	-0.066 (0.17)
Education (Post-HS)							
No HS	---	-0.36 (0.14)**	-0.33 (0.15)	-0.372 (0.148)**	-0.28 (0.19)	-1.12 (0.39)	-0.25 (0.27)
HS Grad/GED	---	-0.22 (0.13)	-0.25 (0.13)	-0.29 (0.13)	-0.27 (0.17)	-0.44 (0.37)	-0.29 (0.26)
Total Household Income (Under $5000)							
$5,000-9,999	---	-0.18 (0.15)	-0.19 (0.16)	-0.18 (0.16)	-0.27 (0.22)	-0.15 (0.54)	0.030 (0.23)
$10,000-14,999	---	0.11 (0.16)	0.059 (0.17)	0.053 (0.17)	0.20 (0.22)	-0.83 (0.50)	-0.052 (0.29)
$15,000-19,999	---	0.12 (0.16)	0.17 (0.17)	0.16 (0.17)	0.25 (0.23)	-0.78 (0.50)	0.12 (0.27)

Characteristics	**All Women**				**Black Women Only**	**White Women Only**	**Hispanic Women Only**
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 4**	**Model 4**	**Model 4**
$20,000-24,999	---	0.033 (0.17)	-0.0024 (0.18)	-0.006 (0.18)	-0.13 (0.23)	0.14 (0.50)	0.50 (0.36)
$25,000-29,999	---	0.16 (0.19)	0.095 (0.19)	0.13 (0.20)	0.089 (0.25)	0.30 (0.59)	0.19 (0.38)
$30,000-34,999	---	-0.22 (0.20)	-0.15 (0.21)	-0.16 (0.21)	-0.050 (0.27)	-0.68 (0.59)	-0.55 (0.41)
$35,000-39,000	---	0.20 (0.25)	0.19 (0.25)	0.21 (0.25)	0.27 (0.32)	-0.98 (0.64)	0.64 (0.64)
$40,000+	---	0.18 (0.20)	0.20 (0.20)	0.20 (0.20)	0.19 (0.26)	0.27 (0.50)	0.53 (0.64)
Alcohol Use (Ref: Yes)	---	---	-0.014 (0.10)	-0.017 (0.10)	-0.025 (0.13)	-0.042 (0.25)	0.058 (0.20)
Tobacco Use (Ref: Yes)	---	---	0.15 (0.12)	0.16 (0.12)	0.19 (0.16)	0.25 (0.25)	-0.26 (0.25)
Parity (2 or more)							
None	---	---	-0.12 (0.13)	-0.13 (0.13)	-0.28 (0.18)	0.15 (0.38)	0.26 (0.23)
One	---	---	0.043 (0.13)	0.033 (0.13)	0.076 (0.17)	-0.26 (0.34)	0.059 (0.21)
Race/Ethnicity (White NH)							
Black NH	-0.69 (0.17)***	-0.70 (0.19)***	-0.81 (0.17)***	-0.75 (0.20)***	---	---	---
Latina/Hispanic	-0.25 (0.17)	-0.18 (0.19)	-0.31 (0.20)	-0.26 (0.21)	---	---	---
Other	-0.34 (0.28)	-0.25 (0.31)	-0.26 (0.32)	-0.22 (0.32)	---	---	---

***p<0.05; **p<0.01; ***p<0.001**

Figure C.1: Distribution of gestational age, SPEAC 1999-2004



N	#Missing	Min	Max	Mean	Median	Mode	Std. Dev.	Range	Skew	Kurt
3795	154	15	45	38.56	39	40	2.59	30	-2.93	13.59

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