CHAMBERS, BRITTANY D., PhD. Assessing the Association of County-level Structural Racism and Social and Economic Deprivation with Women's Prenatal Care Utilization and Adverse Birth Outcomes. (2017)
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There is a growing body of research showing community- and state-level indicators of structural racism and social and economic deprivation are associated with prenatal care utilization and adverse birth outcomes among African American women. However, even after controlling for individual characteristics and community poverty, racial inequities in prenatal care utilization and adverse birth outcomes are still present. There is limited research on the effect of structural racism and social and economic deprivation when measured at the county-level on adverse birth outcomes. This study contributes to previous research by using a novel conceptualization and measurement of structural racism and social and economic deprivation to better understand racial inequities in prenatal care utilization and adverse birth outcomes. Cross-sectional birth record data (2009-2013) from women residing in California (n= 531,170) were linked to county-level data gathered from the American Community Survey (2009-2013) to conduct multilevel analyses. This study was guided by the ecosocial theory and was centered on examining the association of exposures to structural racism (e.g., residential segregation and African American and White ratios in political participation) and embodied racial inequities in adverse birth outcomes between African American and White women through two mediated pathways: (1) social and economic deprivation, and (2) prenatal care utilization.

Outcome variables in this study were infants' birth weight (measured in grams) and gestational age (measured in weeks). Women receiving less than adequate prenatal care (i.e., initiating prenatal care after the first trimester and attending 79% or less of recommended appointments) served as a secondary outcome variable. Structural racism was measured by residential segregation indices (i.e., dissimilarity, isolation, and concentration) and African American and White ratios in the number of persons incarcerated for felonies and in board of supervisor positions at the county-level. Social and economic deprivation was measured by two African American to White ratios: in having a professional and/or management job, and in having a high school diploma or higher at the county-level. Chapters 4 and 5 are two papers included in this dissertation that sought to answer the following research questions: (1) Are both traditional and novel indicators of county-level structural racism associated with adverse birth outcomes among African American and White women?; (2) Do both traditional and novel measures of county-level structural racism account for racial inequities seen in adverse birth outcomes among African American and White women?; and (3) Do county-level indicators of social and economic deprivation account for racial inequities seen in African American and White women's prenatal care utilization?

Among women included in the study sample, African American women birthed infants of lower average birth weight and earlier average gestational age, with corresponding higher percentages of infants meeting criteria for low birth weight and preterm birth in comparison to White women. Additionally, African American women,

compared to White women, were more likely to have less than adequate prenatal care utilization.

Traditional indicators of structural racism (i.e., isolation and dissimilarity) were associated with African American and White women's infants' birth weight and gestational age, after controlling for individual characteristics and county-level poverty. There was a significant interaction between race (i.e., African American) and traditional indicators of structural racism (i.e., isolation) with infants' gestational age, where African American women who lived in counties with high isolation birthed infants at earlier gestational ages. The main effect of race on infants' birth weight and gestational age remained significant across all models. *Novel* indicators of structural racism were associated with infants' birth weight among both African American and White women. There were no statistically significant interactions between race and novel indicators of structural racism with infants' birth weight.

Only one indicator of social and economic deprivation was associated with women's prenatal care utilization, adjusting for individual characteristics and county-level poverty. Findings indicate increasing the number of African Americans by one to every 100 Whites in professional jobs at the county-level, increased women's likelihood of having less than adequate prenatal care by 1.03 odds. Race remained significant after accounting for individual-level factors and county poverty; however, there were no significant interactions between race and African American to White ratios in professional jobs.

Findings from this study highlight the utility of county-level measures of structural racism and social and economic deprivation in understanding factors related to prenatal care utilization and adverse birth outcomes among African American and White women. Future studies should examine more comprehensive approaches to measure structural racism and social and economic deprivation to better understand the structural influences affecting racial inequities in prenatal care utilization and adverse birth outcomes.

ASSESSING THE ASSOCIATION OF COUNTY-LEVEL STRUCTURAL RACISM AND SOCIAL AND ECONOMIC DEPRIVATION WITH WOMEN'S PRENATAL CARE UTILIZATION AND ADVERSE BIRTH OUTCOMES

by

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

LIST OF ABBREVIATIONS

MIH	Maternal and Infant Health
PTB	Preterm Birth
LBW	Low-Birth Weight
CDC	Centers for Disease Control and Prevention
PNC	Prenatal Care
HP	Healthy People
U.S.	United States
WHO	The World Health Organization
HIV	The Human Immunodeficiency Virus
ACOG	American College of Obstetricians and Gynecologists
USDHHS	US Department of Health and Human Services
Kessner Index	Kessner Adequacy of Prenatal Care Index
APCU Index	Adequacy of PNC Utilization Index
ACA	The Affordable Care Act

CHAPTER I

INTRODUCTION

Statement of the Problem

Nationally and in individual states (i.e., California), maternal and infant health (MIH) inequities persist for African American women in the United States (U.S.). Preterm births (PTB) and low-birth weight (LBW) are the top two leading causes of infant mortality (Centers for Disease Control and Prevention [CDC], 2015a). African American women are also more than two times as likely to experience infant mortality compared to White women (Mathews, MacDorman, & Thoma, 2015). African American women are also two to three times more likely to have PTB and LBW compared to White women (Hamilton, Martin, Osterman, Curtin, & Matthews, 2016). PTB and LBW are associated with long-term developmental (e.g., cognitive) (Botting, Powls, Cooke, & Marlow, 1998; Farooqi, Adamsson, Serenius, & Hägglöf, 2016; Taylor & Clark, 2016) and adult health (e.g., cardiovascular disease and diabetes) issues (Li et al., 2015; Rich-Edwards, 1999). Due to the immediate- and long-term consequences of PTB and LWB, there is an imperative need to identify factors associated with these MIH issues.

Inequities in adverse birth outcomes between African American and White women continue even after controlling for exposure to individual-level factors (i.e., socioeconomic and marital status, risk-taking behaviors, stress, and infection

(Beck et al., 2002; Berg, Wilcox, & d'Almada, 2001; Braveman et al., 2015; Colen, Geronimus, Bound, & James, 2006; Cox, Zhang, Zotti, & Graham, 2011; Lu et al., 2010; Partridge, Balayla, Holcroft, & Abenhaim, 2012; Wadhwa et al., 2001). There is a growing body of research showing community-level factors such as poverty and structural racism are related to adverse birth outcomes. Research supports community- and state-level indicators of structural racism are positively associated with adverse birth outcomes among African American women, but even after controlling for community poverty, the racial inequity in adverse birth outcomes is still present (Bell, Zimmerman, Almgren, Mayer, & Huebner, 2006; Britton & Shin, 2013; Grady, 2006; Grady & Ramírez, 2008; Mason, Messer, Laraia, & Mendola, 2009; Messer, Oakes, & Mason, 2010; Wallace, Mendola, Liu, & Grantz, 2015). There is also limited research on the effect of structural racism, including factors such as dissimilarity, isolation, and incarceration, when measured at the county-level with women's adverse birth outcomes (Nyarko & Wehby, 2012).

In an effort to better understand racial inequities in adverse birth outcomes between African American and White women, it is important to examine the association of structural racism and the possibility of mediated pathways at different geographic scales because racism may operate differentially, adversely impacting health issues. Furthermore, a better understanding of how prenatal care (PNC) utilization, educational attainment, and job status and employment may affect racial inequities in adverse birth outcomes using a theoretical framework that accounts for the complex pathways of structural racism is crucial.

Study Purpose and Specific Aims

The purpose of this study was to examine the mediated role clinical (i.e., prenatal care utilization) and structural (social and economic deprivation) pathways have on the relationship between structural racism and adverse birth outcomes among African American and White women living in California. This study used the *ecosocial theory* (Krieger, 2012) to guide the analysis of data from California birth records. This study specifically investigated the following aims:

Aim 1: Examine the direct association between county-level indicators of structural racism and social and economic deprivation with women's adverse birth outcomes, including moderation by race.

Aim 2: Examine the direct association between county-level indicators of structural racism and social and economic deprivation on women's prenatal care utilization, including moderation by race.

> Aim 2A: Examine the mediating role of women's prenatal care utilization on the direct association between county-level indicators of structural racism and social and economic deprivation on women's adverse birth outcomes, including moderation by race.

Conclusion

Racial inequities in adverse birth outcomes still exist between African American and White women. Even after controlling for individual-level factors and community-level poverty, racial inequities in adverse birth outcomes remain. A growing body of research has been examining the association structural racism may have on adverse birth

outcomes; however, there is limited research on county-level structural racism and its potential impact on women's adverse birth outcomes. The next chapter will highlight existing literature related to individual- and community-level factors associated with adverse birth outcomes, and the potential gaps in the literature this study addressed.

CHAPTER II

LITERATURE REVIEW

Maternal and Infant Health Indicators

Maternal and infant health (MIH) indicators are widely used to assess population health (Dominguez, 2008, 2010; Healthy People [HP] 2020, 2016; Reidpath & Allotey, 2003). MIH indicators encompass the social (e.g., chronic stress and access to health care) and physical (e.g., infant growth) determinants of health for both mother and infant (HP 2020, 2017). By many of these markers, the United States (U.S.) lags behind other industrialized countries. For example, in 2015, the U.S. had an estimated infant mortality rate (measured globally as infant deaths from birth to under five years of age) of 6.5 per 1,000 live births, greatly exceeding that of Japan (2.7 per 1,000 infant deaths), France (4.3 per 1,000 infant deaths), and Germany (3.7 per 1,000 infant deaths) (The World Health Organization [WHO], 2016). Preterm births (PTB) (infants born before 37 weeks of gestation) and low-birth weight (LBW) (infants born weighing less than 2,500 grams/5 pounds, 8 ounces) are the top two leading causes of infant mortality (CDC, 2015a). PTB and LBW are also associated with long-term cognitive developmental problems (Botting et al., 1998; Farooqi et al., 2016; Taylor & Clark, 2016) and health issues in adulthood (e.g., cardiovascular disease and diabetes) (Li et al., 2015; Rich-Edwards, 1999).

Infant mortality, PTB, and LBW are not evenly distributed by racial groups. African American women have more than double the infant mortality rate (measured nationally as infant deaths from birth to 12 months) of White women (11.11 compared to 5.06 per 1,000 live births) (Mathews, MacDorman, & Thoma, 2015). African American women also have significantly higher rates of PTB compared to White women (13.0 versus 8.9 preterm births per 1,000 live births) (Hamilton, Martin, Osterman, Curtin, & Matthews, 2016). Similar inequities between African American and White women are seen in infants born at LBW (12.8 versus 7.0 low-birth weights per 1,000 live births) (Hamilton et al., 2015). African American women are also more likely to have complications during pregnancy (Kharrazi et al., 2012) and disproportionate rates of infants perinatally-infected with the human immunodeficiency virus (HIV) compared to White women (CDC, 2015b).

Individual and Interpersonal Risk Factors

Inequities in adverse birth outcomes between African American and White women are attributed to exposure to individual risk factors during pregnancy. These factors include: mothers' socioeconomic status, health risk behaviors (i.e., smoking during pregnancy), experiences of stress, and health complications during pregnancy.

Socioeconomic Status. The most commonly studied explanation for the impact of racial inequities on adverse birth outcomes is the role of the mother's socioeconomic status, such as income, education, and employment (Berg et al., 2001; Braveman et al., 2015; Colen et al., 2006; Starfield et al., 1991). Lower socioeconomic status is associated with LBW, PTB, and infant mortality (Berg et al., 2001; Braveman et al., 2015; Colen et

al., 2006; Starfield et al., 1991). Although socioeconomic status appears to be a meaningful variable to explain adverse birth outcomes among White and African American women, research consistently shows that controlling for socioeconomic status does not eliminate racial inequities in adverse birth outcomes (Berg et al., 2001; Braveman et al., 2015; Colen et al., 2006; Starfield et al., 1991).

Smoking during Pregnancy. Traditionally, studies have assessed smoking during pregnancy to account for racial inequities in adverse birth outcomes due to its strong associations with PTB and intrauterine growth restriction (Beck et al., 2002; Chasnoff, Landress, & Barrett, 1990; Ebrahim, Floyd, Merritt, Decoufle, & Holtzman, 2000; Goldenberg et al., 1996; Serdula, Williamson, Kendrick, Anda, & Byers, 1991). Although White women report more cigarette smoking during pregnancy as compared to African American women (Beck et al., 2002; Ebrahim et al., 2000), African American women who do not smoke cigarettes during pregnancy are more likely to have adverse birth outcomes compared to White women who do smoke cigarettes during pregnancy (Goldenberg et al., 1996; Singh & Yu, 1995). Therefore, cigarette use during pregnancy cannot accurately explain racial inequities in adverse birth outcomes between African American and White women.

Stress. Research suggests that stress during pregnancy can negatively impact the mother's biological pathways causing infection (e.g. urinary tract infections, bacterial vaginosis), thus increasing a women's risk for PTB and LBW (Copper et al., 1996; Giscombé & Lobel, 2005; Lobel, Dunkel-Schetter, & Scrimshaw, 1992; Mustillo et al., 2004; Wadhwa et al., 2001; Wadhwa, Entringer, Buss, & Lu, 2011). Psychological stress

is usually measured as perceived stress during pregnancy or a stressful life-time event (Copper et al., 1996; Lobel et al., 1992). Although exposure to psychological stress experienced during pregnancy is associated with adverse birth outcomes much like cigarette use, that association does not fully explain racial inequities (Collins et al., 2000; Giscombé & Lobel, 2005; Mustillo et al., 2004). In fact, some studies have shown that White women experience more stress during pregnancy compared to African American women (Copper et al., 1996; Lobel et al., 1992). In contrast, other studies have revealed that African American women report experiencing more stress during pregnancy in comparison to White women (Collins et al., 2000; Giscombé & Lobel, 2005; Mustillo et al., 2004; Wallace et al., 2013). This can be due, in part, to measurements of psychological stress not accurately accounting for social exposures to stress African American women experience during pregnancy and across the life-course such as racism (Collins et al., 2000; Dominguez, 2008; Giscombé & Lobel, 2005; Lu & Halfon, 2003; Mustillo et al., 2004).

Complications during Pregnancy. Gestational diabetes and hypertension increases pregnancy, labor, and birth complications for both mother and infant (Bodnar, Ness, Markovic, & Roberts, 2005; Heslehurst et al., 2008; Premkumar, Henry, Moghadassi, Nakagawa, & Norton, 2016; Sibai et al., 2000). For example, gestational diabetes is associated with infants being born large-for-gestational age (Heslehurst et al., 2008; Sibai et al., 2000), and gestational hypertension is connected with intrauterine growth restriction in mothers (Bodnar et al., 2005; Premkumar et al., 2016), resulting in PTB and LBW infants. African American ,compared to White, women are more likely to

report pregnancy-related hypertension and diabetes when adjusting for pre-existing hypertension, diabetes, and maternal age (Bodnar et al., 2005; Heslehurst et al., 2008; Premkumar et al., 2016; Sibai et al., 2000). However, studies have shown that taking into account gestational diabetes and hypertension does not erase racial inequities in adverse birth outcomes (Bodnar et al., 2005; Heslehurst et al., 2008; Premkumar et al., 2016; Sibai et al., 2000).

Prenatal Care Utilization and Adverse Birth Outcomes

Adequate prenatal care (PNC) utilization has been identified as an effective tool to reduce adverse birth outcomes (CDC, 2011; HP 2020, 2016; Shiono & Behrman, 1995). Adequate PNC can result in the early detection of health complications and diagnoses for mother and infant by providing women access to healthcare, educational and nutritional support, and social services (CDC, 2011). Inadequate or no PNC is associated with an increased risk of PTB, LBW, still birth, early and late neonatal death, infant mortality (Cox et al., 2011; Partridge et al., 2012; Xaverius, Alman, Holtz, & Yarber, 2016), and perinatal HIV (CDC, 2015b).

Measuring PNC. There are differing criteria for standard or sufficient PNC. Specific to low-risk pregnancies, the American College of Obstetricians and Gynecologists (ACOG) (1997) recommends approximately 14 PNC visits during pregnancy. Soon after ACOG (1997) implemented their recommendations, the US Public Health Care Services developed criteria for standard PNC, stressing the importance of initiating PNC during the first trimester of pregnancy (US Department of Health and Human Services [USDHHS], 2000). Two primary ways to measure PNC utilization

emerged from these standards: the Kessner Adequacy of PNC Index (Kessner Index) and the Adequacy of PNC Utilization Index (APCU Index) (Bloch, Dawley, & Suplee, 2009). Both the Kessner and APCU Index take into account the month that PNC is initiated and number of PNC visits attended (Kessner, Singer, Kalk, & Schlesinger, 1973; Kotelchuck, 1994). However, scholars argue the APCU Index is a more comprehensive measurement compared to the Kessner Index because it includes the category "adequate plus," which measures women's experiences with intensive care and high-risk pregnancies as well as accounts for the percentage of PNC women receive while adjusting for gestational age (Bloch et al., 2009; Kotelchuck, 1994). Furthermore, research shows that the Kessner and APCU indices provide statistically different results regarding the proportion of women who received inadequate PNC, with the APCU Index providing more conservative findings (Bloch et al., 2009; Kotelchuck, 1994).

Inequities in PNC. Maternal characteristics such as age (i.e., being less than 18 years old), educational level (i.e., having less than a high school diploma), and marital status (i.e., being unmarried) are associated with women's PNC utilization (Frisbie, Echevarria, & Hummer, 2001; Johnson et al., 2007; Partridge et al., 2012; Roberts & Nuru-Jeter, 2010; York et al., 1999). Women's health behaviors such as cigarette smoking are also associated with inadequate or no PNC, regardless of race or ethnicity (Frisbie et al., 2001; Johnson et al., 2007; Partridge et al., 2012; Roberts & Nuru-Jeter, 2010). In comparison to White women, African American women, are more likely to identify with groups at-risk for inadequate PNC (e.g., lower educational level, unmarried), (Frisbie et al., 2001).

African American women are more likely to receive inadequate PNC compared to White women (Frisbie et al., 2001; Johnson et al., 2007; Partridge et al., 2012; Roberts & Nuru-Jeter, 2010; Xaverius et al., 2016; York et al., 1999). As a result of the Affordable Care Act (ACA), there was an increase in the percentage of women who had healthcare insurance, primarily through Medicaid, during pregnancy and delivery (D'Angelo et al., 2015). However, African American women, as well as women who are less than 35 years old, low-income (i.e., defined as living 200% below the federal poverty line) and have less than a high school education, still reported unstable insurance statuses after the implementation of the ACA (D'Angelo et al., 2015).

Accessibility to PNC continues to be an issue for African American women compared to White women as African American women are more likely to have Medicaid or no health care insurance and lack a reliable form of transportation (Baffour & Chonody, 2009; Phillippi, 2009). Barriers like lack of health care insurance and transportation, and use of Medicaid negatively impact birth outcomes (Baffour & Chonody, 2009; Bengiamin, Capitman, & Ruwe, 2010; Phillippi, 2009). This is partially due to a lack of medical providers that accept Medicaid patients, resulting in overcrowded medical facilities and extended wait times (Bengiamin et al., 2010).

When individual and interpersonal factors are controlled for, African American women are more likely to receive inadequate PNC during pregnancy compared to White women (Frisbie et al., 2001; Partridge et al., 2012). There are conflicting results on the extent to which PNC reduces racial inequities in adverse birth outcomes. Some studies have found inadequate or no PNC is a significant predictor for infant mortality, PTB, and

low- and very-low birth weight among African American women (Collins, David, Simon, & Prachand, 2007; Cox et al., 2011). Although other studies have found that even when there is an increase in PNC utilization, racial inequities in adverse birth outcomes persist (Collins & David, 2009; Collins, Wall, & David, 1997; Xaverius et al., 2016). Racial inequities in adverse birth outcomes and inadequate PNC are associated with individual and interpersonal risks factors such as socioeconomic status and health risk behaviors. However, these individual and interpersonal risk factors do not account for all of the variation seen between African American and White women's adverse birth outcomes and PNC utilization, warranting further investigation to understand racial inequities.

Theoretical Perspectives

Emerging research has explored racism as a factor associated with racial inequities in adverse birth outcomes and PNC by incorporating the life-course perspective (Collins et al., 2000; Dominguez, 2008; Giscombé & Lobel, 2005; Mustillo et al., 2004; Nuru-Jeter et al., 2009) and ecosocial theory (Wallace et al., 2015). The life-course perspective and ecosocial theory both acknowledge that historical and contemporary exposures to traumas and stress, such as racism, shape health inequities.

Life-Course Perspective. The life-course perspective posits racial inequities in birth outcomes are not only a result of exposures to racism during pregnancy, but also to women's exposures during the entire life-course including before pregnancy (Halfon & Hochstein, 2002; Kotelchuck, 2003; Lu et al., 2010; Lu & Halfon, 2003). This work suggests that racial inequities are consequences of differential exposures—both during key developmental periods (e.g., the woman's own childhood and adolescence, in

addition to during her pregnancy) and cumulative across the life-course (Halfon & Hochstein, 2002; Kotelchuck, 2003; Lu et al., 2010; Lu & Halfon, 2003).

The life-course perspective merges elements from two longitudinal models: an early programming model and a cumulative pathways model (Halfon & Hochstein, 2002; Kotelchuck, 2003; Lu et al., 2010; Lu & Halfon, 2003). The *early programming model* argues that exposures during a woman's childhood impact her later birth outcomes (Halfon & Hochstein, 2002; Kotelchuck, 2003; Lu & Halfon, 2003; Lu et al., 2010). Studies have shown a relationship between high levels of persistent stress reactivity in adulthood and perinatal stress (Halfon & Hochstein, 2002; Kotelchuck, 2003; Lu et al., 2010; Lu & Halfon, 2003). Specific to African American women, exposure to stress during childhood/adolescence and pregnancy is associated with adverse birth outcomes (Halfon & Hochstein, 2002; Kotelchuck, 2003; Lu et al., 2010; Lu & Halfon, 2003). The *cumulative pathway model* suggests that wear and tear, or *allostatic load*, on the body's adaptive systems is the result of chronic accommodations to exposures to stress during childhood and across the life-course (Halfon & Hochstein, 2002; Kotelchuck, 2003; Lu et al., 2010; Lu & Halfon, 2003; Nuru-Jeter et al., 2009). Over time, poor health and body functioning occurs due to constant exposure to stress across the life-course (Halfon & Hochstein, 2002; Kotelchuck, 2003; Lu et al., 2010; Lu & Halfon, 2003). Together, the *early programming* and *cumulative pathway* models can account for exposures to trauma across the life-course, such as racism.

Ecosocial Theory. The ecosocial theory posits that societal and ecological context exposures (e.g., social and economic deprivation, inadequate medical care,

exogenous hazards, and social traumas) are biologically embodied by individuals, thus resulting in health inequities (Krieger, 1994, 2001, 2010, 2011, 2012). There are four components of the ecosocial theory (Krieger, 1994, 2001, 2010, 2011, 2012). First, *embodiment* acknowledges that people are biologically integrated in their societal and ecological context, as well as the social and material worlds in which they live (Krieger, 2012). Second, pathways of embodiment are *multifaceted* and potentially concurrent and interacting (e.g., biological, physiological, behavioral, and environmental). Third, the *cumulative interplay* of exposure, susceptibility, and resistance across the life-course recognizes the significance of historical and contemporary embodied exposures and accumulated effects, incorporating gene expression rather than gene frequency (Krieger, 2012). Lastly, *accountability and agency* stresses the importance of sharing research findings to disrupt racial inequities.

Recently, scholars have used the ecosocial theory to account for the complexity of structural racism and its potential effects on health (Kramer & Hogue, 2009; Wallace et al., 2015). In the context of understanding structural racism as a driver of health inequities, the ecosocial theory postulates: (1) biological expressions of racism are created and perpetuated through inequitable race relations used to benefit a superior group, deeming other groups inferior; (2) biological constructs are racialized to categorize and demarcate people into racial/ethnic groups; and (3) inequitable environmental conditions are produced via embodiment, resulting in "biological expressions of racism" (Krieger, 2012). The ecosocial theory, then, allows researchers to account for racism as an oppressive and exploitative process encompassing multiple

levels and pathways across historical generations and the life-course (Krieger, 2012). The ecosocial theory has been used to examine the association of community-level segregation with adverse birth outcomes (Kramer & Hogue, 2009; Krieger, 2012; Wallace et al., 2015).

Perceived and Structural Racism with MIH Indicators

Racism is defined as a perceived threat formed on an immutable characteristic often central to a person's identity, resulting in unequal treatment based on skin color and other physical attributes (Nuru-Jeter et al., 2009). Racism constitutes a severe threat to a person's health and wellbeing through chronic stress (Nuru-Jeter et al., 2009). Racism-related stress involves psychosocial challenges such as prejudice, individual and structural discrimination, and denigration experienced across the life-course and in multiple domains including: school, work, home, and community settings (Collins et al., 2000; Dominguez, 2008; Giscombé & Lobel, 2005; Mustillo et al., 2004; Wallace et al., 2015). The majority of studies focused on *individual perceptions of racism*, primarily using a validated scale of perceived everyday racial discrimination (Collins et al., 2000; Dominguez, 2008; Giscombé & Lobel, 2005; Mustillo et al., 2004), while emerging studies focused on *structural racism* through residential segregation indices (Bell et al., 2006; Britton & Shin, 2013; Grady, 2006; Grady & Ramírez, 2008; Mason et al., 2009; Messer et al., 2010; Wallace et al., 2015).

Perceived Racism and Adverse Birth Outcomes. Perceived racism (occurrences of direct and indirect experiences of racism across the life-course and during day to day functioning) is associated with adverse birth outcomes experienced by African American

women, including PTB and LBW and infants being born small for gestational age (Collins et al., 2000; Dominguez, 2008; Giscombé & Lobel, 2005; Mustillo et al., 2004). Assessing perceived racism alone may underestimate the impact of racism-related stress across the life-course on African American women's pregnancy experiences and birth outcomes (Nuru-Jeter et al., 2009; Wallace et al., 2015).

Perceived Racism and PNC. Studies have also shown a relationship between inadequate and no PNC and racial discrimination in healthcare settings among African American women (Slaughter-Acey, Caldwell, & Misra, 2013; Ward, Mazul, Ngui, Bridgewater, & Harley, 2013). African American women expressed feeling discriminated against while receiving PNC due to the interplay between their race, experiences of racial discrimination across the life-course, and healthcare insurance status (Ward et al., 2013). Controlling for individual- and interpersonal-level factors, denial of group-based discrimination was moderately associated with inadequate PNC among African American women (Slaughter-Acey et al., 2013).

Measuring Structural Racism. Structural racism is defined as systematic laws and processes used to allocate resources and opportunities to advantage Whites over African Americans in society (Massey & Denton, 1988; Massey, White, & Phua, 1996). Structural racism is traditionally measured by residential segregation indices (Massey & Denton, 1988; Massey et al., 1996). Segregation is defined as a spatial and compositional distribution of one group of people compared to another group across communities, representing a multilevel construct explaining cross-scale variances (i.e., social groups and areal units) (Massey & Denton, 1988). There are five dimensions of residential

segregation: evenness, exposure, concentration, centralization, and clustering (Massey & Denton, 1988). Evenness is the variability in two social groups' distribution across a city's areal units (Massey & Denton, 1988). Exposure assesses the extent to which a potential interaction or contact between two social group members within a city's areal units may occur (Massey & Denton, 1988). Concentration is the amount of physical space one social group has across an areal unit (Massey & Denton, 1988). Centralization is the extent to which one social group is spatially located near the center of areal units (Massey & Denton, 1988). Clustering is the extent to which groups of people from one social group reside in adjoining areal units (Massey & Denton, 1988).

Residential segregation is a valid measurement of structural racism in the U.S. due to the aftermath of the enslavement of Africans through the use of collective action racism (i.e., institutionalized laws and legislation to separate Blacks from Whites) and centralized racism (i.e., an operative process used to maintain separation between Blacks and Whites) to geographically separate African Americans from Whites and allocate resources accordingly (Kramer & Hogue, 2009). Furthermore, segregation takes into account the isolation of groups of people (i.e., African Americans) from "amenities, opportunities, and resources that affect social and economic wellbeing" (Massey & Denton, 1989, p. 373). For example, racial and ethnic segregation is reported at higher rates between African Americans and Whites, followed by between Whites, Latinos, and Asians (Farley & Frey, 1994; Iceland & Wilkes, 2006). Despite shifts in segregation, African Americans across all socioeconomic groups still lived in more highly segregated areas compared to Whites and other racial/ethnic groups (Iceland & Wilkes, 2006).

Research on racial and ethnic segregation suggests that Whites are more tolerant of living in communities with Asians and less tolerant of living in communities with African Americans (Nyden, Leachman, Peterman, & Coleman, 1998; Yinger, 1995). In contrast, African Americans reported being more willing to live in integrated communities (Charles, 2003; Farley & Frey, 1994), but face discrimination in the mortgage and housing markets when controlling for income (Logan & Alba, 1995; Yinger, 1995). Although these sources are dated, community segregation between African Americans and Whites in the U.S. represent a unique social stratification historically situated in racism.

The majority of studies assessed the impact of community segregation on racial/ethnic and income lines using metropolitan statistical areas and census tracts as the geographic scale (Acevedo-Garcia, Lochner, Osypuk, & Subramanian, 2003). Studies consistently show that racial segregation is a stronger predictor of health inequities than income segregation, with the interaction between racial and income segregation exhibiting strong effects on spatial isolation among people living in poverty (Charles, 2003; Jargowsky, 1997; Massey & Denton, 1993). However, studies have also used other contextual factors such as crime rates, educational attainment, and job status to measure structural racism (Messer, Kaufman, Dole, Savitz, & Laraia, 2006; Wallace et al., 2015). For example, Lukachko, Hatzenbuehler, and Keyes (2014) introduced a novel approach to measure structural racism across four domains, assessing African American to White ratios at the state-level in political participation, job status and employment, educational attainment, and judicial treatment. Findings suggest African Americans who live in states

with higher levels of structural racism (i.e., political participation, employment, and incarceration) were more likely to report myocardial infarction compared to African Americans living in states with lower levels of structural racism (Lukachko, 2014). State level structural racism was not associated with Whites myocardial infarctions (Lukachko, 2014).

Communities have been classified in many ways across U.S. studies: census tracts, census block groups, community clustering, metropolitan statistical areas, states, counties, and zip codes (Acevedo-Garcia et al., 2003; Kramer & Hogue, 2009; Mason et al., 2009; Messer et al., 2010). More recent literature argues that "indicators of structural racism extend beyond community contexts to include national, state, and local laws, institutional policies, and political infrastructures that differentially and adversely affect members of a particular racial group," and proposes the use of other geographic scales (e.g., state- and county-level) as indicators of structural racism (Lukachko et al., 2014, p. 44). Exposures to structural racism may operate differently by geographic scale, where social context and health policies represent distinct scale patterns at the levels of metropolitan statistical areas, census tracts, counties and states (Bird, 1995; Massey, Rothwell, & Domina, 2009).

There has been dialogue in regards to the most accurate way to measure structural racism. Scholars are beginning to use counties as geographic areas to assess health inequities due to uneven distribution of resources across counties such as access to health care and differing social and political context (Bambhroliya, Burau, & Sexton, 2012; Gutnik & Castro, 2016; Hipp, 2015; Jia, Moriarty, & Kanarek, 2009; Sommers, Chua,

Kenney, Long, & McMorrow, 2015). Furthermore, some counties across the U.S. have the power to allocate positions of power and to distribute resources, which can affect segregation within county offices (California State Association of Counties, 2014).

Structural Racism and Adverse Birth Outcomes. The association between structural racism and inequities in adverse birth outcomes varies across studies. At the community-level (with census tracts, census block groups, and metropolitan areas serving as the geographic scale), isolation, dissimilarity, deprivation, and crime rates are positively associated with adverse birth outcomes among African American women, after controlling for community poverty (Bell et al., 2006; Britton & Shin, 2013; Elo et al., 2009; Grady, 2006, 2010; Grady & Ramírez, 2008; Janevic et al., 2010; Messer et al., 2010; O'Campo et al., 2008). Similar results are reported among state-level indicators of racism (i.e., political participation, employment and job status, educational attainment, and judicial treatment) and infants being born small for gestational age (Wallace et al., 2015). In contrast, community clustering is associated with more optimal birth outcomes among African American women, specifically LBW and PTB, after controlling for community poverty (Bell et al., 2006; Grady, 2010). There are inconsistent results on the association of community segregation on adverse birth outcomes for White women (Elo et al., 2009; Grady, 2006, 2010; Grady & Ramírez, 2008; Janevic et al., 2010; Mason et al., 2009; Messer et al., 2006, 2010). Findings from these studies provide evidence that residential segregation may explain racial inequities in adverse birth outcomes above and beyond community poverty. Inequities in adverse birth outcomes persist, despite the increased variation explained by indicators of structural racism.

Mediating Factors: Structural Racism and Adverse Birth Outcomes. Part of the reason that structural racism may be only partially explaining adverse outcomes is that the relationship between structural racism and adverse birth outcomes may not always be direct. Both individual- and community-level factors have been identified as mediated pathways, demonstrating a more complex process at work. Three mediated pathways associated with structural racism and adverse birth outcomes have been investigated: (1) individual social, behavioral, and economic factors (i.e., mother's education, marital status, smoking, and chronic disease), (2) medical risks (i.e., pregnancy-related hypertension, chronic lung disease) and (3) community characteristics (i.e., metropolitan statistical area crime rates) (Grady & Ramírez, 2008; Kramer, Cooper, Drews-Botsch, Waller, & Hogue, 2010) (see Figure 1).

As can be seen in Figure 1 below, the association between community isolation and low-birth weight was mediated by medical risk (Grady & Ramírez, 2008). Hypertension (i.e., chronic and pregnancy-related) mediated the association between community isolation and low-birth weight among African American women, while hypertension and lung disease mediated the relationship for White women (Grady & Ramírez, 2008). Similarly, the association between community isolation and preterm birth was mediated by both individual-level factors and by community-level factors (Kramer et al., 2010). Socioeconomic status and community crime rates partially mediated the relationship between community isolation and preterm births among African American women (Kramer et al., 2010). However, no studies to date have

examined access to PNC as a mediator between indicators of racism and adverse birth outcomes.

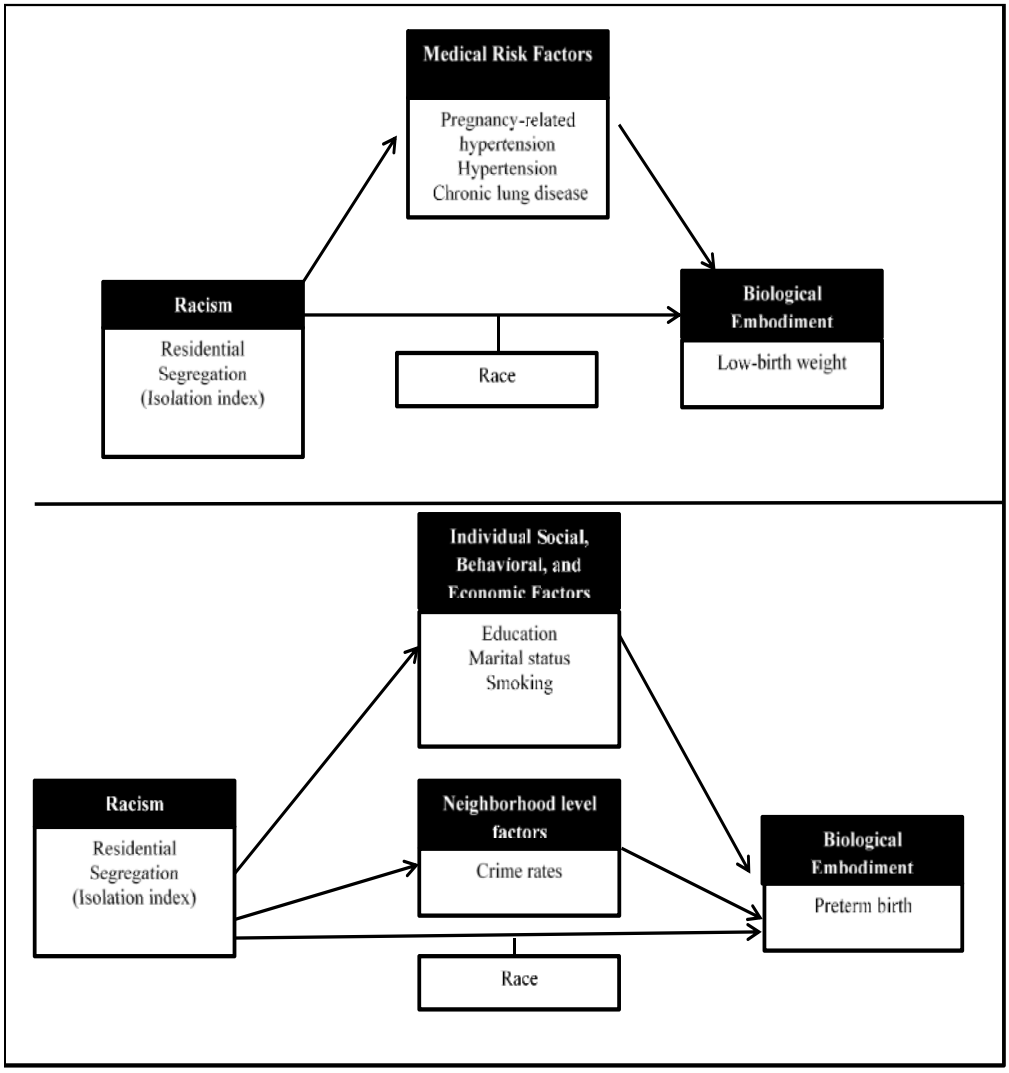

Figure 1. Illustration of Mediated Pathways Examined in Grady and Ramirez (2008) and Kramer et al. (2010)

Structural Racism, Social and Economic Deprivation, and PNC. There is limited research on associations between indicators of structural racism and PNC utilization, with the majority of studies focusing on relationships between community indicators of social and economic deprivation (factors highly correlated with structural racism) and PNC utilization (Cubbin et al., 2008; Perloff & Jaffee, 1999). In one study, associations between indicators of structural racism (measured by community deprivation) had a negative association for White women and a positive association for African American women (Cubbin et al., 2008). Cubbin and colleagues (2008) found that African American women who live in low-deprivation (e.g., more access to resources) communities were more likely to initiate late or no PNC compared to African American women from moderate-deprivation communities. This is in contrast to White women who live in high-deprivation (e.g., access to fewer resources) communities, who were more likely to initiate late or no PNC compared to White women from moderate-deprivation communities (Cubbin et al., 2008). In contrast, Perloff and Jaffee (1999) found no association between distressed communities (i.e., low economic opportunity) and late initiation of PNC among a predominately White sample. This indicates an inconsistency in how indicators of social and economic deprivation affect White women. These findings also provide evidence that racial inequities in PNC utilization continue to occur despite access to community resources, suggesting that a community measure exploring structural racism may be a stronger predictor.

Strengths and Limitations of Literature

There is a plethora of research on racial inequities in MIH. It is well-established that inequities in adverse birth outcomes persist between African American and White women after controlling for individual and clinical (i.e., PNC utilization) factors. A shift in the literature to incorporate the impact of structural racism has emerged, resulting in a more nuanced way to understand racial inequities in adverse birth outcomes.

Despite this shift, there are gaps in the current literature examining the impact of indicators of structural racism on inequities in adverse birth outcomes. First, although there is a strong relationship between indicators of structural racism and adverse birth outcomes, accounting for this relationship does not eliminate racial inequities. Wallace and colleagues (2015) conducted the only study to date that has used novel indicators of structural racism, specifically measuring the ratio of African Americans to Whites in job status and employment, educational attainment, and judicial treatment at the state-level. This study found that high inequities in structural racism (i.e., ratio of African Americans to Whites in job status and employment, educational attainment, and judicial treatment) increased the odds for African American and White women to have infants born small for gestational age (Wallace et al., 2015). There is currently no published research that examines the effects of structural racism (i.e., political participation, educational attainment, job status and employment, and judicial treatment) on PTB and LBW, the top two leading causes of infant mortality.

Second, there are inconclusive findings on the affect of PNC on adverse birth outcomes, with the majority of studies concluding that a lack of PNC is associated with

lower infant birth weights and higher PTB. There is limited research on structural racism, and the extent to which it reduces racial inequities in PNC utilization. What is unclear is the mediated role PNC may play in the relationship between indicators of structural racism and adverse birth outcomes.

Lastly, this study focused on counties as the geographic scale. Traditionally, researchers have used census tracts or metropolitan areas as geographic scales to assess the impact of structural racism on adverse birth outcomes. Counties represent governing bodies with the power to allocate laws and distribute resources, thus impacting the health and wellbeing of its constituents. Using counties as the geographic scale allows for the measurement of how resource allocation impacts access to care and health outcomes (Bambhroliya et al., 2012; Gutnik & Castro, 2016; Hipp, 2015; Jia et al., 2009; Sommers et al., 2015). More work is needed to provide empirical data on the contribution of structural racism on inequities in adverse birth outcomes.

In response, this study included two aims:

Aim 1: Examine whether there is a direct association between county-level indicators of structural racism and social and economic deprivation with women's adverse birth outcomes, including moderation by race.

Aim 2: Examine whether there is a direct association between county-level indicators of structural racism and social and economic deprivation on women's prenatal care utilization, including moderation by race.

Aim 2A: Examine if women's prenatal care utilization is a mediator of the direct association between county-level indicators of structural racism and social and

economic deprivation on women's adverse birth outcomes, including moderation by race.

Conclusion

Although individual –level factors such as socioeconomic status are associated with adverse birth outcomes, they do not explain racial inequities in adverse birth outcomes. The life-course perspective and ecosocial theory have been used to examine the impact of racism-related stress on inequities in adverse birth outcomes between African American and White women. African American women have a unique position in the American society making them susceptible to exposures to racism across the life-course, resulting in embodied health inequities. Community segregation has been used excessively in birth outcomes research to examine the association between structural racism and racial inequities. Although the use of community segregation indices has advanced our understanding of adverse birth outcomes, racial inequities persist. It remains unknown how community segregation and novel approaches to measure structural racism operate at the county-level to influence racial inequities in adverse birth outcomes. The next chapter discusses the methods used to operationalize and examine the impact of traditional and novel indicators of structural racism on women's birth outcomes, and the mediated roles social and economic deprivation and PNC utilization play in this relationship.

CHAPTER III

METHODOLOGY

Study Design and Setting

This study used a cross-sectional multilevel design to examine the association between indicators of structural racism and adverse birth outcomes among women living in California. It further examined the potential individual- and community- level pathways—primarily social and economic indicators—by which this association may occur. The state of California was the study setting due to its diverse racial/ethnic population and unique governance. The geographic scale for this study was counties in California. Similar to the United States (U.S.), inequities in adverse birth outcomes are seen between African American and White women in California, and vary by county (March of Dimes, 2016). Multilevel modeling was used to account for variability in birth outcomes across counties, and to test specific mechanisms by which structural racism may work at the county-level.

California is a unique state due to its population size and demographic diversity, as well as differences in the governance power of counties. In 2015, California had an estimated population of 39,144,818, including 72.9% White and 6.5% African American (the racial groups of interest in this study) (U.S. Census, 2016). In addition, 38.8% of state residents reported Hispanic/Latino as their ethnicity (U.S. Census, 2016). California

is the third largest state in the U.S. and is comprised of 58 counties grouped in 9 distinct regions: Northern California (e.g., Del Norte), Northern Sacramento Valley (e.g., Butte), Greater Sacramento (e.g., El Dorado), Bay Area (e.g., Alameda), San Joaquin Valley (e.g., Fresno), Central Sierra (e.g., Alpine), Central Coast, (e.g., Monterrey), Southern California (e.g., Los Angeles), and San Diego-Border (e.g., San Diego) (California Department of Social Services, 2002).

California is comprised of general (n=44) and charter (n=14) counties, representing two distinct governance powers at the county-level. General counties have to adhere to state-level laws, but in contrast charter counties have "home rule" and can allocate positions of power and distribution resources, which can affect segregation within county offices (California State Association of Counties, 2014). Every county in California has the opportunity to adopt a charter county by a majority vote (California State Association of Counties, 2014).

Adverse birth outcomes in California vary by race and county. In regards to PTB, approximately 13% were to African American women and 9% to White women (March of Dimes, 2016). Among infants born of LBW, 11.5% were to African American women and 6% were to White women (March of Dimes, 2016). In addition, inequities in birth outcomes vary drastically across counties (March of Dimes, 2016). There is recent data on adverse birth outcomes for 17 of the 58 California counties; Table 1 displays percentages of LBW and PTB across these 17 counties. Although there are consistent

inequities in PTB and LBW within all counties, greater within-county inequities are seen in some counties like Fresno and Tulare, warranting further investigation.

Table 1. Average Percent of Preterm Births and Low Birth Weight by California Counties

	Preterm Births		Low Birth Weight	
	African American	White	African American	White
	Percent		Percent	
U.S.	**16.2%**	**10.7%**	**12.9%**	**7.0%**
California	**13.1%**	**9.2%**	**11.3%**	**6.2%**
Alameda	11.8%	8.7%	10.1%	6.3%
Contra Costa	12.5%	8.6%	10.6%	5.9%
Kern	14.3%	10.6%	12.4%	6.6%
Orange	11.2%	8.3%	9.9%	6.0%
Riverside	12.6%	9.3%	10.8%	6.0%
Fresno	17.0%	10.8%	15.1%	7.0%
Los Angeles	13.7%	9.8%	11.8%	6.5%
San Diego	11.8%	8.5%	9.8%	6.0%
Sacramento	11.8%	8.0%	10.4%	5.6%
San Bernardino	14.5%	10.1%	12.4%	6.5%
San Joaquin	14.9%	9.4%	12.8%	6.1%
Santa Clara	10.0%	8.5%	8.8%	6.2%

Note: March of Dimes only provides birth outcomes information on 17 out of the 33 Counties of California that will be included in this study.

Theoretical Framework. The ecosocial theory guided the study design and analyses. As mentioned in Chapter 2, the ecosocial theory posits that societal and ecological context exposures are biologically *embodied* by individuals, resulting in health inequities representing four constructs: *multifaceted* pathways of embodiment*,* *cumulative interplay* of exposure*,* susceptibility, resistance across the life-course, and *accountability and agency* (Krieger, 2012). Indicators of structural racism are hypothesized to affect adverse birth outcomes through mediated pathways (i.e., social and economic deprivation, social trauma, targeted marketing, inadequate medical care,

responses to discrimination, ecosystem degradation and land alienation, and toxins, hazards, and pathogens (Krieger, 2012).

Applying the ecosocial theory, this study acknowledged that race and race relations systematically advantage Whites over African Americans in U.S. society, generating "inequitable living and working conditions that, via embodiment, result in the biological expression of racism—and hence racial/ethnic health inequities" (Krieger, 2012, p. 937). This study was particularly centered on exposures to structural racism and *embodied* inequities in adverse birth outcomes between African American and White women through two mediated pathways: (1) social and economic deprivation, and (2) inadequate medical care. Indicators of structural racism, which were operationalized as dissimilarity and isolation segregation, and African American to White ratios in political participation and incarceration, were hypothesized to have a direct association with African American and White women's adverse birth outcomes. Indicators of structural racism were also hypothesized to have an indirect effect on African American and White women's adverse birth outcomes through prenatal care utilization (PNC). This study acknowledged the interplay between indicators of structural racism and social and economic deprivation, but was also interested in examining the direct effect indicators of social and economic deprivation had on African American and White women's adverse birth outcomes, and if this relationship was mediated through women's prenatal care utilization (see Figure 2). This study did not investigate the direct association between county-level structural racism and social and economic deprivation.

Data Source

This study used the California Birth Statistical Master Files for years 2009-2013. The Central Valley Health Policy Institute of Fresno State University granted permission to use this dataset for this study (see Appendix A). These data are cross-sectional and represent women's birth outcomes for the corresponding time points obtained from birth certificates. This dataset represents the most comprehensive and largest available birth data and includes maternal, parental, and infant characteristics, as well as medical information (e.g., preeclampsia, STI infections) pertaining to the birth. Appendix B displays all variables included in the dataset. Geographic information related to mother's place of residence during birth such as census tract, state, county, and zip code level are provided, allowing linkage between these data and contextual information available through the U.S. Census American Community Survey (2009-2013). The Institutional Review Board (IRB) at the University of North Carolina, Greensboro deemed this study exempt (see Appendix C).

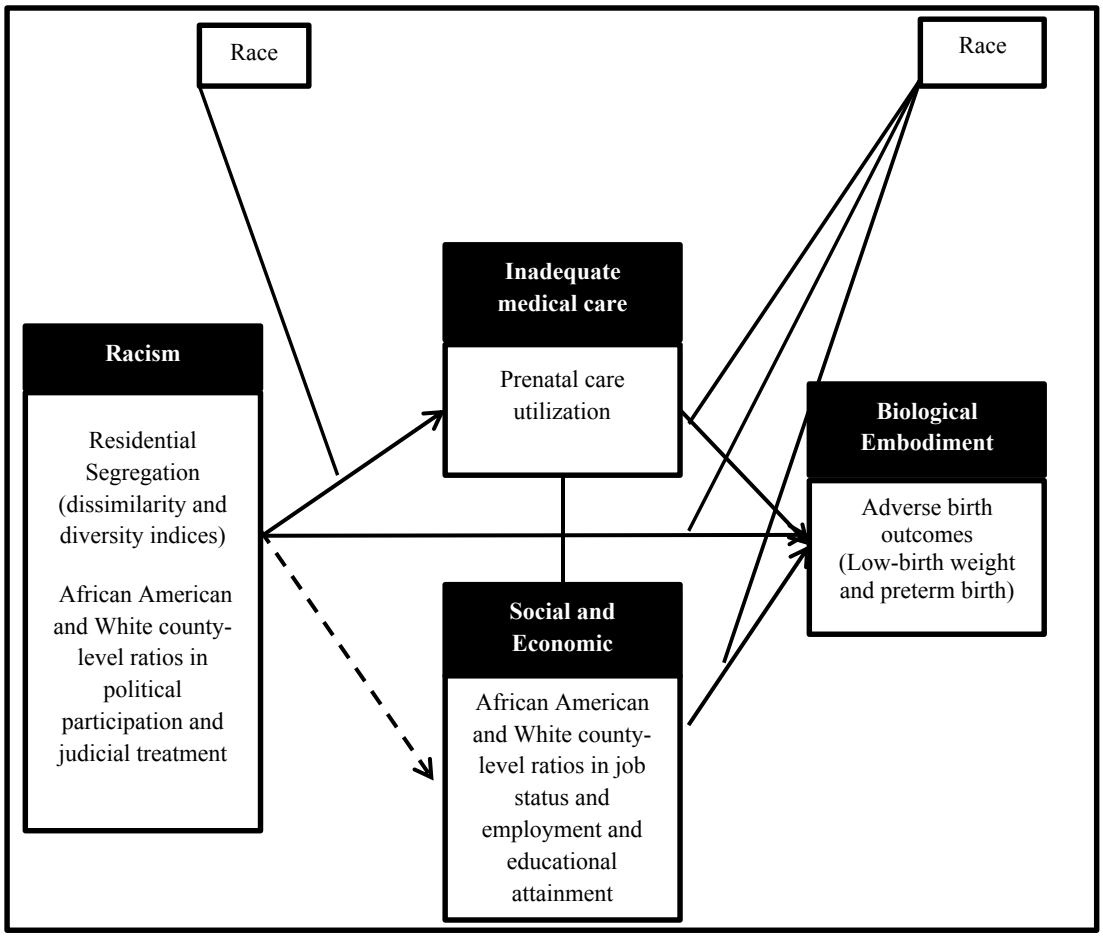

Figure 2. Conceptual Model for this Study

Study Sample

This study focused on non-Hispanic African American and White women as understanding how structural racism operates for African American individuals which is a first step in reducing health inequities. Women who had previous births and pregnancy terminations were excluded from the study due to the possible ways that prior experiences with pregnancy and PNC may affect their current care regime (Bell et al., 2006). Women with multiple births were excluded because multiples (e.g., twins and

triplets) are more likely to be of lower-birth weight and younger gestational age (Bell et al., 2006). This study also focused on women who carried pregnancies post 20 weeks and before 44 weeks, as those birthed before may be representation of stillbirths among the sample or inaccurate reporting (Bell et al., 2006). For similar rationales, women who gave birth to infants less than 500 grams or greater than 6,000 grams were excluded from the study (Bell et al., 2006). Additionally, the study was limited to women who reported California residence due to this study's focus on the effect of structural indicators of structural racism and social and economic deprivation among women residing in California. Table 2 provides the numerical breakdown of the selection procedures.

There were also county-level study criteria. Residential segregation indices are less reliable in areas with small proportions of African Americans (Bell et al., 2006; Iceland & Weinberg, 2002; Massey et al., 1996). In one study using counties as the geographic scale to assess the association of residential segregation on county-level adverse birth outcomes, the researchers limited the study to areal units with population sizes 100,000 or greater and counties with at least 50 births to African American women for the study period (Nyarko & Wehby, 2012). Therefore, this study was limited to 33 counties within California.

Table 2. Selection Procedures for Study Sample

Total Sample	2,546,270
Non-Hispanic	1,232,911
Singleton Births	1,183,998
First Birth	1,183,998
California Resident	1,180,638
No previous Terminations	951,385
African American or White only	609,985
Pregnancy carried 20 > 44 weeks	608,264
Infant birth weight 500 > 6,000 grams	607,959
Missing Data on individual-level variables	561,361
County-level criteria	531,170

Sensitivity Analysis

Table 3 shows comparison analyses between African American and White women who were included and excluded from this study. Women excluded from this study were more likely to White, of older age, use public insurance for PNC, have complications during pregnancy and adverse birth outcomes. In contrast, women included in this study were more likely to use cigarettes during pregnancy and receive less than adequate PNC.

Study Measures

Outcome Variables. PTB and LBW served as the dependent variables. PTB and LBW are the top two leading causes of infant mortality (CDC, 2015a). Further, these birth outcomes affect long-term cognitive developmental (Botting et al., 1998; Farooqi et al., 2016; Taylor & Clark, 2016) and health issues in adulthood (e.g., cardiovascular disease and diabetes) (Li et al., 2015; Rich-Edwards, 1999). PTB was measured by infants' gestational age in weeks, while LBW measured by infant's weight in grams.

Table 3. Sensitivity Analysis Comparing Individual Characteristics and Birth Outcomes between Women Included and Excluded from the Study (N = 833,301)

	In Study n = 531170	Excluded from Study n = 302131	Total n = 833301
Individual Characteristics	% (n)	% (n)	% (n)
Race**			
African American	16.7 (88815)	15.9 (44910)	16.4 (133725)
White	83.3 (442355)	84.1 (238263)	83.6 (680618)
	mean (SD)	mean (SD)	mean (SD)
Age**	29.05 (5.879)	30.42 (6.15)	29.51 (6.01)
	% (n)	% (n)	% (n)
Insurance**			
Private	64.6 (342875)	60.9 (170182)	62.9 (513057)
Public	32.8 (174364)	36.1 (100746)	33.7 (275110)
Self-Pay	3.6 (19038)	3.1 (8536)	3.4 (27574)
Cigarette use during pregnancy**			
No	96.2 (511203)	97.1 (274969)	96.5 (786172)
Yes	3.8 (19967)	2.9 (8204)	3.5 (28171)
Complications during pregnancy**			
Diabetes	3.4 (17965)	4.8 (13576)	3.9 (31541)
Hypertension	3.5 (18532)	4.8 (13581)	3.9 (32113)
Prenatal Care Utilization**			
Adequate	72.2 (383256)	77.0 (212334)	73.8 (595590)
Less than Adequate	27.8 (147914)	23.0 (63468)	26.2 (211382)
Birth Outcomes			
*Gestational Age (weeks)***	38.92(1.717)	37.96 (4.10)	
Full Term (> 37 weeks)	94.1 (499788)	85.7 (240329)	91.1 (740117)
Preterm (< 37 weeks)	5.9 (31382)	14.4 (40518)	8.9 (71900)
*Birth Weight (grams)****	528.941(3382.62)	3219.63 (682.26)	
Normal Weight (>2500 grams)	95.5 (507487)	87.6 (248200)	92.8 (755687)
Low-Birth Weight (<2500 grams)	4.5 (23683)	12.4 (34973)	7.2 (58656)

Note: Racial differences in means (i.e., age) were assessed using ANOVA. Race differences for categorical variables (i.e., insurance, cigarette use, pregnancy complications, and PNC) were assessed using Chi-square analysis. ** = p-value < 0.01, * = p-value < 0.05.

Mediating Variable. The recommended number of PNC visits was determined based on the American College of Obstetricians and Gynecologists (ACOG) (2007) guidelines of one PNC visit every four weeks for the first trimester, every two weeks for the second trimester, and every week during the third trimester, totaling approximately 14 visits across a 40-week healthy pregnancy. PNC utilization was measured by Kotelchuck's (1994) Adequacy of PNC Utilization Index (APCU Index). The APCU Index combines two separate measures of PNC utilization, PNC initiation and number of visits attending accounting for gestational age of infant at birth classifying care as: inadequate (i.e., initiation of PNC after 4 months or attended less than 50% of recommended visits), intermediate (i.e., initiation of PNC between the first or fourth month of pregnancy and attended between 50% to 79% of recommended visits), adequate (i.e., initiation of PNC between the first or fourth month of pregnancy and attended between 80% to 109% of recommended visits, capturing pregnancies exceeding 40 weeks), and adequate plus (i.e., initiation of PNC between the first or fourth month of pregnancy and attended 110% of recommended visits, capturing high risk pregnancies). Each category is adjusted according to gestational age, accounting for PTB. APCU Index is the most commonly used measurement of PNC utilization due to the adequate plus group being able to capture women who have intensive PNC due to complications during pregnancy (Bloch et al., 2009; Kotelchuck, 1994). Across all categories of PNC utilization among the study sample, women who received adequate plus PNC were less likely to be diagnosed with hypertension or diabetes compared to women who received adequate, intermediate, or inadequate PNC. For the purposes of data analysis, the APCU

Index was dichotomized to Adequate (adequate/adequate plus) vs. Less than Adequate (intermediate/inadequate).

Individual–Level Independent Variables. Maternal characteristics and behaviors, source of payment for PNC, access to supportive services, and complications during pregnancy served as individual-level independent variables. Maternal characteristics included mother's race, age, and educational level. Mother's race was the primary individual-level independent variable. Mother's race was categorized as either non-Hispanic African American or White. Age was a continuous variable. Cigarettes used during pregnancy served as the maternal health risk behavior and was measured by any reported cigarette use across the three trimesters vs. no cigarette use during pregnancy. Source of payment for PNC measured the type of insurance each woman used during pregnancy with three distinct insurance categories: private, public, or self-pay. Complications during pregnancy were measured by two dichotomous variables: diabetes (i.e., before and/or during pregnancy) and hypertension (i.e., before and/or during pregnancy).

County-Level Independent Variables. The primary independent variables were indicators of structural racism. Traditional indicators of structural racism were measured by residential segregation indices. Residential segregation is the most commonly used proxy for indicators of racism (Massey & Denton, 1988). There are five dimensions of residential segregation: evenness, exposure, concentration, centralization, and clustering (Massey & Denton, 1988). This study focused on evenness, exposure, and concentration, as they have been identified as the three most important dimensions of residential

segregation. Evenness is the variability in two social groups' distribution across a city's areal units (Massey & Denton, 1988). Exposure assesses the extent to which a potential interaction or contact between two social group members within a city's areal units may occur (Massey & Denton, 1988). Concentration is the amount of physical space one social group has across an areal unit (Massey & Denton, 1988).

Evenness was measured by the dissimilarity index (D):

$$D = \frac{1}{2}\sum_{i=1}^{n}\left[\frac{x_i}{X} - \frac{w_i}{W}\right]$$

where x_i and w_i are the African American and White population, respectively, for the i^{th} census tract. X and W are the African American and White population, consecutively, of the entire county. The dissimilarity index ranges from 0 (complete integration) to 1 (completed segregation) and is interpreted as the percent of non-Hispanic African Americans who would have to move out of the county to obtain full integration.

Exposure was measured by the isolation index ($x\ P^*x$):

$$xPx^* = \sum_{i=1}^{n}\left[\left(\frac{x_i}{X}\right)\left(\frac{x_i}{t_i}\right)\right]$$

x_i and X are as defined above, and t_i is the total population (African Americans + Whites) in the census tract. Responses range between 0 (complete integration) and 1 (complete segregation), and is interpreted as the probability an African American will interact with another African American in their county.

Concentration was measured by the delta index (Del):

$$Del = \frac{1}{2}\sum_{i=1}^{n}\left[\frac{x_i}{X} - \frac{a_i}{A}\right]$$

x_i and X are as defined above. a_i and A are the total area in the *i*th census tract and county, respectively. Responses range between 0 (complete integration) and 1 (complete segregation), and is interpreted as the proportion of African Americans that would have to change their place of residence to achieve uniform density of African Americans across a county.

Lukachko and colleagues (2014) proposed using states as the geographic scale to measure structural racism arguing that "indicators of structural racism extend beyond community contexts to include national, state, and local laws, institutional policies, and political infrastructures that differentially and adversely affect members of a particular racial group" (p. 44). As 24% of California counties have the power to adopt and amend laws and regulations affecting the flow of resources and the diversity of county governance (California State Association of Counties, 2014), this study measured racism at the county-level due to the potential uneven distribution of resources across and within counties such as access to and availability of health care and resources (Bambhroliya et al., 2012; Gutnik & Castro, 2016; Hipp, 2015; Jia et al., 2009; Sommers et al., 2015).

Given the tremendous racial inequities between African American and White people in wealth, credit, educational attainment, employment, income, and rates of incarceration, Lukachko and colleagues (2014) introduced a novel approach to measure

structural racism across four domains - political participation, job status and employment, educational attainment, and judicial treatment. Due to the shift in the geographic scale from state- to county-level, items for each indicator are not available. Table 4 displays how Lukachko and colleagues' (2014) indicators of structural racism were conceptualized and measured in this study. This study measured novel county-level indicators of structural racism across two of these domains: political participation and judicial treatment. Political participation and judicial treatment align with causations of structural racism, which is conceptualized as a social dynamic construct systematically (through laws, messages, attitudes, and beliefs), grouping people and allocating resources to advantage "Whites" over "African Americans" in society (Jones, 2001; Smedley & Smedley, 2005; West, 2002). Racism functions by developing and perpetuating a dominant cultural orientation of privilege and discrimination encompassing universal values, principles, and beliefs in institutions such as schools, churches, governments, social service agencies, and others that lack cultural and racial diversity (Graham, Brown-Jeffy, Aronson, & Stephens, 2011; Jones, 2001). Political participation was measured by the ratio of African American to White members of the Board of Supervisors, the governing body for counties in California. Information was gathered from each board of supervisor website and the best interpretation of each supervisor's race/ethnicity based upon appearance and origin of last name. Approximately 55% of supervisors' race/ethnicity was confirmed via their Wikipedia or Facebook accounts. Judicial treatment was measured by the ratio of African American to White people incarcerated due to a felony. Applying the ecosocial theory to novel indicators of structural racism, the

domains of job status and employment and educational attainment were reconceptualized as measurements of social and economic deprivation.

Novel indicators of social and economic deprivation were constructed using three pieces of county-level information: job status and employment, educational attainment, and poverty. Job status and employment was measured by two items: the ratio of African Americans to Whites at the county-level who are in (1) executive managerial positions, and (2) a professional specialty. Educational attainment was measured by the African American to White ratio of those who had at least a bachelor's degree. Poverty also served as a county-level independent variable. County-level poverty was measured by the percentage of persons living below the federal poverty-line at the county-level.

Research Aims and Questions

Aim 1: Examine whether there is a direct association between county-level indicators of structural racism and social and economic deprivation with women's adverse birth outcomes, including moderation by race.

Rationale for Aim 1: This aim examined the extent to which specific indicators of structural racism - county-level community segregation, political participation, and judicial treatment—were associated with adverse birth outcomes among African American and White women residing in California (see Figure 3). To date, there is only one study that has assessed indicators of structural racism outside of community segregation, and the study found that state-level indicators of structural racism were significantly associated with infants being born small for gestational age (Wallace et al., 2015). Different results may be found assessing these domains on a different geographic

scale (county-level verses state-level), and with similar, yet, distinctive adverse birth outcomes (gestational age and birth weight).

Question 1.1: Are county-level indicators of structural racism differentially associated with adverse birth outcomes for African American and White women?

Hypothesis 1.1: County-level indicators of structural racism will be significantly associated with adverse birth outcomes among African American and White women. County-level dissimilarity, isolation, concentration, and the African American to White ratio in incarceration will be negatively associated with adverse birth outcomes, while the African American to White ratio in board of supervisor positions will be positively associated with adverse birth outcomes. The level of exposure to structural racism will impact African American and White women's adverse birth outcomes differently. It is hypothesized higher levels of segregation and inequity at the county-level will be more likely to decrease infants born to African American women's gestational age and birth weight compared to infants born to White women living in similar counties.

Question 1.2: Are county-level African American to White ratios in social and economic deprivation differentially associated with adverse birth outcomes for African American and White women?

Hypothesis 1.2: County-level social and economic deprivation will be positively associated with adverse birth outcomes among African American and White women. As the African American to White ratio in educational attainment and job status increases infants born to African American and White women's gestational age and birth weight will also increase. Ratios in social and economic deprivation will differently impact

adverse birth outcomes to African American women, in comparison to White women. It is hypothesized higher racial equity in social and economic deprivation will be associated with higher gestational age and birth weight among infants born to African American women compared to infants born to White women.

Table 4. Description of Measurement of Novel Indicators of Structural Racism Items

Indicator of Structural Racism	Lukachko et al. (2014)	Current Study	Description for Current Study	Data Source (Date)
Political participation	Registered to vote Voted State elected officials	County board of supervisors	The ratio of Black/Whites who were elected as county board of supervisors	County board of supervisors website (2016; years served ranged from 1-22)
Employment and job status	Civilian labor Employed Executive/managerial position Professional specialty	Executive/managerial position Professional specialty	The ratio of Black/Whites at the county-level who are in executive managerial position and professional specialty	American Community Survey. U.S. Census (2009-2013)
Educational attainment	Bachelor's degree or higher	Bachelor's degree or higher	The ratio of Black/White at the county-level who attained a bachelor's level degree or higher	American Community Survey. U.S. Census (2009-2013)
Judicial treatment	Incarcerated Disenfranchised Death row	Felony incarcerations	The ratio of Black/White at the county-level who are incarcerated for a felony.	Center on Juvenile and Criminal Justice (2012)

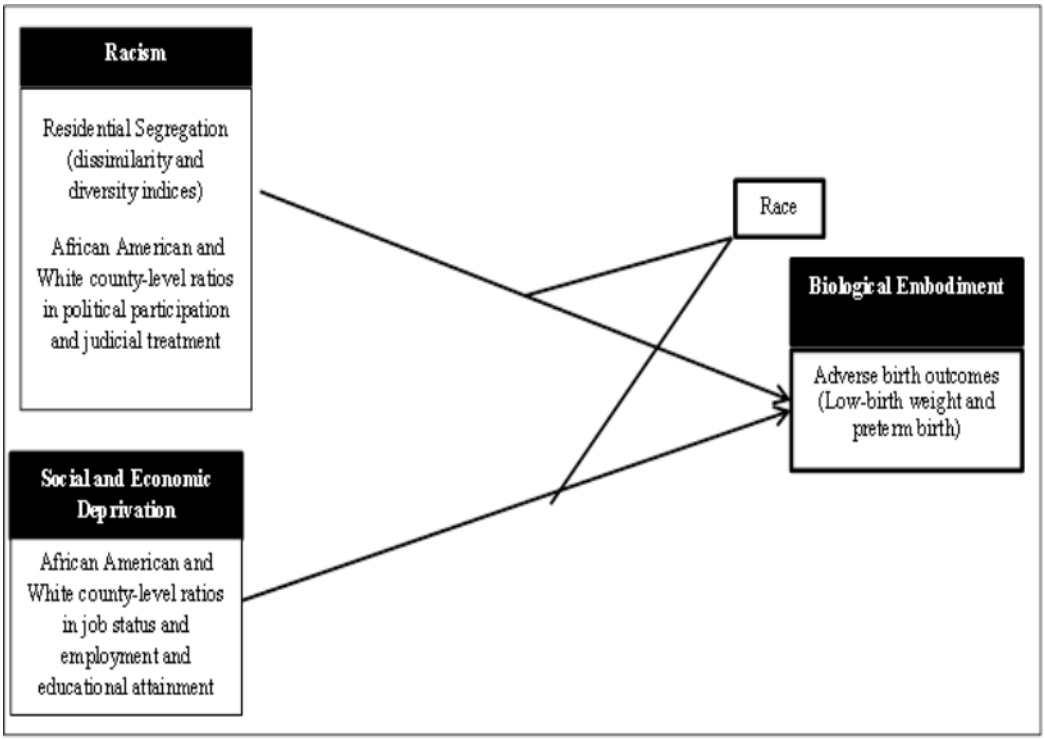

Figure 3. Aim 1 Conceptual Model

Aim 2: Examine whether there is a direct association between county-level indicators of structural racism and social and economic deprivation on women's prenatal care utilization, including moderation by race.

Rationale for Aim 2: This aim provided insights on whether, to what degree, and how indicators of structural racism are related to inadequate medical care (i.e., PNC utilization) among African American and White women (see Figure 4). Inadequate PNC has been identified as a significant component in reducing adverse birth outcomes yet differentially affects African American and White women (Frisbie et al., 2001; Johnson et al., 2007; Partridge et al., 2012; Xaverius et al., 2016; York et al., 1999). Research consistently shows indicators of structural racism are significant predictors of adverse

birth outcomes among African American women, with inconclusive evidence of the impact of structural racism on White women (Grady, 2006, 2010; Grady & Ramírez, 2008; Janevic et al., 2010; Mason et al., 2009; Messer, Kaufman, Dole, Savitz, & Laraia, 2006; Messer et al., 2010). There is limited research on the relationship between structural racism on PNC utilization, with limited studies assessing its association with indicators of social and economic deprivation (Cubbin et al., 2008; Perloff & Jaffee, 1999).

Question 2.1: Are county-level indicators of racism differently associated with PNC utilization for African American and White women?

Hypothesis 2.1: County-level indicators of structural racism will be significantly associated with PNC utilization among African American and White women. County-level dissimilarity, isolation, concentration, and the African American to White ratio in incarceration will be positively associated with receiving less than adequate PNC , while the African American to White ratio in board of supervisor positions will be negatively associated with receiving less than adequate PNC. The level of exposure to structural racism will impact African American and White women's PNC utilization differently. It is hypothesized higher levels of segregation and inequity at the county-level will increase the odds of African American women receiving less than adequate PNC to White women living in similar counties.

Question 2.2: Are county-level social and economic deprivation differently associated with PNC utilization for African American and White women?

Hypothesis 2.2: County-level social and economic deprivation will be negatively associated with PNC utilization among African American and White women. As the African American to White ratio in educational attainment and job status increases the odds of African American and White women receiving less than adequate PNC will decrease. Ratios in social and economic deprivation will differently impact African American women's PNC utilization, in comparison to White women. It is hypothesized higher racial equity in social and economic deprivation will decrease the odds of African American women receiving inadequate PNC compared to White women.

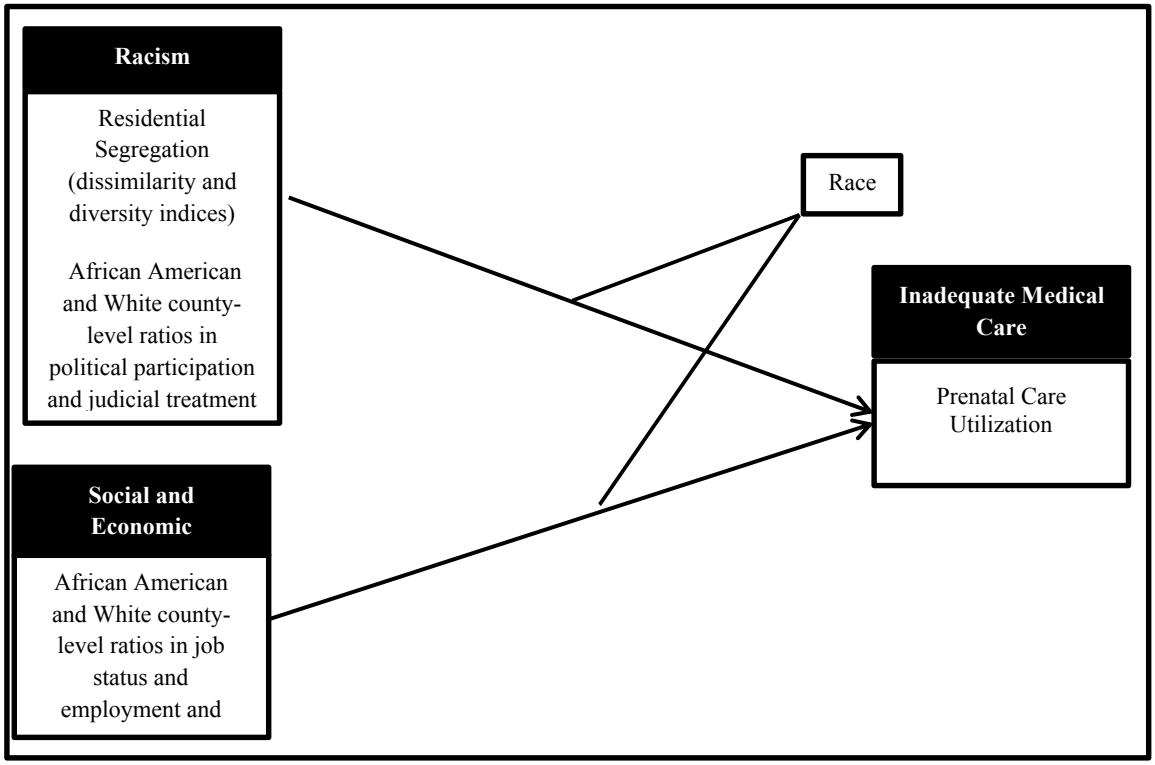

Figure 4. Aim 2 Conceptual Model

Aim 2A: Examine if women's prenatal care utilization is a mediator of the direct association between county-level indicators of structural racism and social and economic deprivation on women's adverse birth outcomes, including moderation by race.

Rationale for Aim 2A: This aim explored if the relationship between indicators of structural racism and adverse birth outcomes was mediated through inadequate medical care (i.e., PNC utilization) among African American and White women (see Figure 2). There are few studies examining the direct association of PNC utilization and adverse birth outcomes (Frisbie et al., 2001; Johnson et al., 2007; Partridge et al., 2012; Xaverius et al., 2016; York et al., 1999), with no studies examining the indirect pathway PNC utilization may play in the relationship between indicators of structural racism and social and economic deprivation and adverse birth outcomes.

Question 2A.1: Does PNC utilization mediate the relationship between county-level indicators of structural racism and adverse birth outcomes differentially for African American and White women?

Hypothesis 2A.1: The relationship between indicators of structural racism and adverse birth outcomes will partially be mediated through PNC. It is hypothesized higher levels of segregation and inequity at the county-level will be more likely to decrease infants born to African American women who received less than adequate PNC gestational age and birth weight compared to infants born to White women who received less than adequate PNC living in similar counties.

Question 2A.2: Does PNC utilization mediate the relationship between county-level social and economic deprivation and adverse birth outcomes differentially for African American and White women?

Hypothesis 2A.2: The relationship between indicators of social and economic deprivation and adverse birth outcomes will partially be mediated through PNC. It is hypothesized higher racial equity in social and economic deprivation will be associated with higher gestational age and birth weight among infants born to African American women who received less than adequate PNC compared to infants born to White women who received less than adequate PNC.

Sample Characteristics

In the current study, there were 531,170 primiparous African American and White women who gave birth to singleton infants in California during 2009-2013. Of the final study population, 16.7% were African American and 83.3% White. On average, women in the study were 29.1 years old, used private insurance for PNC (64.6%), and received adequate PNC (72.2%). Relatively few women reported cigarette use during pregnancy (3.8%) or complications with diabetes (3.4%) and/or hypertension (3.5%) prior to or during pregnancy. The average birth weight and gestational age of infants were 3382.6 grams and 38.9 weeks, respectively. About 4.5% of women had infants born at LBW and 5.9% had a PTB (see Table 5).

There were racial differences seen in maternal characteristics and behaviors, source of payment for PNC, adequacy of PNC utilization, complications during pregnancy and birth outcomes. African American women, in comparison to White

women, were on average younger ($\overline{M}$ = 26.3 vs. 29.6 years), and were more likely to have hypertension prior or during pregnancy (4.4% vs. 3.3%) and used public insurance during pregnancy (20.3% vs. 11.0%). On average, White women were slightly more likely to use cigarettes during pregnancy (3.8% vs. 3.6%) and have diabetes complications prior or during pregnancy (3.4% vs. 3.1%). White women also had higher rates of receiving adequate PNC (73.8% vs. 64.0%). African American women on average had infants born at lower birth weight ($\overline{M}$ = 3190.3; 8.7% vs. 3421.2; 3.6%) and earlier gestational age ($\overline{M}$ = 38.6; 8.9% vs. 39.0; 5.4%) (see Table 5).

Table 6 displays descriptive statistics for county-level variables. About 17% of the sample population lived below the federal poverty line. The means for the residential segregation measures represent low, moderate, and high segregation across counties; counties reported low isolation ($\overline{M} = 0.25$), moderate dissimilarity ($\overline{M} = 0.49$), and high concentration ($\overline{M} = 0.80$).

The majority of means for the novel county-level indicators of structural racism and social and economic deprivation were below 1, suggesting African Americans are underrepresented in comparison to Whites (see Table 6). For example, on average for every one Black person across counties there are 11 White people who serve in Board of Supervisors positions. On average for every one African American across counties there were 14 Whites who had a management job and about 17 Whites who had a professional job and/or a bachelor's degree or higher. In contrast, Blacks are overrepresented in prisons across counties in California at 1.09 times that of Whites (see Table 6).

Table 5. Descriptive and Comparison Analysis of Individual-Level Variables (N = 531,170)

Individual Characteristics	**White** **(n = 442355)**	**African American** **(n=88815)**	**Total** **(N = 531,170)**
	mean (SD)	mean (SD)	mean (SD)
Age**	29.6 (5.653)	26. 31 (6.205)	29.05 (5.879)
	% (n)	% (n)	% (n)
Insurance**			
Private	70.6 (312204)	34.5 (30671)	64.6 (342875)
Public	11.0 (48621)	20.3 (17997)	32.8 (174364)
Self-Pay	3.5 (15515)	4.0 (3523)	3.6 (19038)
Cigarette use during pregnancy*			
No	96.2 (425608)	96.4 (85595)	96.2 (511203)
Yes	3.8 (16747)	3.6 (3220)	3.8 (19967)
Complications during pregnancy			
Diabetes**	3.4 (15219)	3.1 (2746)	3.4 (17965)
Hypertension**	3.3 (14624)	4.4 (3908)	3.5 (18532)
Prenatal Care Utilization**			
Adequate	73.8 (326439)	64.0 (56817)	72.2 (383256)
Less than Adequate	26.2 (115916)	36.0 (31998)	27.8 (147914)
Gestational Age (mean)**	38.99 (1.622)	38.61 (2.101)	38.92(1.717)
Full-term (> 37 weeks)	94.7 (418847)	91.1 (80941)	94.1 (499788)
Pre-term (<37 weeks)	5.3 (23508)	8.9 (7874)	5.9 (31382)
Birth Weight (mean)**	3421.24 (511.416)	3190.26 (571.106)	528.941 (3382.62)
Normal birth weight (> 2,500 grams)	96.4 (426390)	91.3 (81097)	95.5 (507487)
Low birth weight (< 2,5000 grams)	3.6 (15965)	8.8 (7718)	4.5 (23683)

Note: Racial differences in means (i.e., age) were assessed using ANOVA. Race differences for categorical variables (i.e., insurance, cigarette use, pregnancy complications, and PNC) were assessed using Chi-square analysis. ** = p-value < 0.01, * = p-value < 0.05.

Table 6. Descriptive Statistics for County-Level Variables (n = 33)

County-level Variables	Mean	Std. Deviation	Range
Poverty			
Living below the federal poverty level	0.17	0.06	0.08-0.27
Indicators of Structural Racism			
Residential Segregation			
Dissimilarity	0.49	0.07	0.35-0.68
Isolation	0.25	0.16	0.02-0.64
Concentration	0.80	0.08	0.56-0.93
Political Participation			
Board of supervisors	0.09	0.22	0.00-1.00
Judicial treatment			
Incarceration	1.09	1.39	0.09-7.10
Social and Economic Deprivation			
Educational Attainment			
Bachelor's degree or higher	0.06	0.05	0.01-0.22
Job status			
Management Job	0.06	0.05	0.01-0.19
Professional Job	0.07	0.06	0.01-0.27

Data Analysis

Univariate analyses were conducted to describe maternal characteristics and behaviors, medical risk factors, source of payment for insurance, and PNC utilization and birth outcomes for the study sample (see Table 5). Frequencies were also provided for categorical variables and measurement of central tendency for continuous variables (see Table 5). Normality of all variables was assessed before determining the appropriate bivariate tests to use. The correlation of individual- and county-level variables can be found in Appendix D. The following statistical analysis and procedures were used to examine specific aims 1, 2, and 3.

Table 7. Bivariate Analyses between County-Level Variables with Women's Birth Weight, Gestational Age and Prenatal Care Utilization

	Birthweight	Gestational Age	Less than Adequate PNC
County-level Variables	**Coefficient**	**Coefficient**	**Odds Ratio**
Poverty	-380.97**	-1.76**	1.51
Incarceration	-12.15*	0.00	1.07
Management Job	-577.76**	-1.12*	11.31
Professional Job	-417.84**	-1.20**	24.23**
Board of Supervisors	-22.16	0.14	0.98
Educational Attainment	-492.01**	-1.22**	16.80*
Concentration	-126.95	-0.66*	0.51
Dissimilarity	-142.26	0.02	0.39
Isolation	-175.81**	-0.32*	2.06

Note: ** = p-value < 0.01, * = p-value < 0.05.

Aim 1: Examine whether there is a direct association between county-level indicators of structural racism and social and economic deprivation with women's adverse birth outcomes, including moderation by race.

Question 1.1: Are county-level indicators of structural racism differentially associated with adverse birth outcomes for African American and White women?

A series of sequential hierarchical general linear models were run in HLM version 7. PTB and LBW were continuous outcome variables, and as a result, this study modeled the likelihood African American or White woman will have a PTB or LBW across individual- and county-level variables. Model 1 included race, and all other maternal characteristics and behaviors, and source of payment for PNC as level-1 covariates. In model 2, the random intercept to account for county-variability in adverse birth outcomes was added. In model 3, county-level poverty was added as a level-2 variable. In model 4, the random intercept for race was added to the model. In models 5-7, level-2 predictors

for indicators of structural racism were added to the model. Model 8 was an intercepts and slopes-as-outcomes model, capturing cross-level interactions between race and indicators of structural racism.

Two computations were calculated to further explain results:

The intra-class correlation (ρ):

$$\rho = \frac{\hat{\tau}_{00}}{\hat{\tau}_{00} + \sigma^2}$$

The proportion of variance explained:

$$\frac{\hat{\tau}_{00}(ANOVA) - \hat{\tau}_{00}(PREDICTOR)}{\hat{\tau}_{00}}$$

where, $\hat{\tau}_{00}$ is the variance of true county differences and σ^2 is the variance of true person-level differences.

Question 1.2: Are county-level indicators of social and economic deprivation differentially associated with adverse birth outcomes for African American and White women?

Similar procedures discussed above with question 1.1 were used to answer question 1.2. Indicators of social and economic deprivation served as the primary county-level predictors.

Aim 2: Examine whether there is a direct association between county-level indicators of structural racism and social and economic deprivation on women's prenatal care utilization, including moderation by race.

Question 2.1: Are county-level indicators of racism differently associated with PNC utilization for African American and White women?

A series of hierarchical general logistic models were run. PNC was a dichotomous variable; therefore, this study modeled the odds than an African American or White woman received less than adequate PNC in comparison to those who received adequate PNC. Model 1 included race, and all other maternal characteristics and behaviors, and complications during pregnancy as level-1 covariates. Model 2 added the random intercept to account for county-variability in PNC utilization. In model 3, county-level poverty was added as a level-2 variable. In model 4, the random intercept for race was added to the model. In models 5-7, level-2 predictors for indicators of structural racism were added to the model separately. Model 8 was an intercepts and slopes-as-outcomes model, capturing cross-level interactions between race and indicators of structural racism.

The intra-class correlation (ρ) was only calculated for model 1, using the following computation:

$$\rho = \frac{\hat{\tau}_{00}}{\hat{\tau}_{00} + \frac{\pi^2}{3}}$$

where $\hat{\tau}_{00}$ is the true county variance and $\frac{\pi^2}{3}$ is the true person-level variance.

Question 2.2: Are county-level African American to White ratios in social and economic deprivation differentially associated with PNC utilization for African American and White women?

Similar procedures discussed above with question 2.1 were used to answer question 2.2. Indicators of social and economic deprivation served as the primary county-level predictors.

Aim 2A: Examine if women's prenatal care utilization is a mediator of the direct association between county-level indicators of structural racism and social and economic deprivation on women's adverse birth outcomes, including moderation by race.

Question 2A.1: Does PNC utilization mediate the relationship between county-level indicators of racism and adverse birth outcomes differentially for African American and White women?

An intercepts and slopes-as-outcomes hierarchical linear model in HLM version 7 was run. Race and PNC utilization served as level-1 predictors, accounting for maternal characteristics and behaviors, medical risk factors, source of payment for insurance, and access to supportive services as level-1 covariates. Indicators of structural racism served as level-2 predictors, controlling for county-level poverty. The slope for race was added to the model. Additionally, interactions between race and indicators of structural racism were added, capturing cross-level interactions between race and structural racism.

Question 2A.2: Does PNC utilization mediate the relationship between county-level African American to White ratios in job status and employment and educational

attainment and adverse birth outcomes differentially for African American and White women?

Similar procedures discussed above with question 2A.1 were used to answer question 2A.2. Indicators of social and economic deprivation served as the primary county-level predictors.

Conclusion

This study used a cross-sectional multilevel design to examine the association of county-level indicators of structural racism and social and economic deprivation with adverse birth outcomes among women living in California, and the mediating role of PNC utilization. Preliminary results revealed African American women were more likely to have adverse birth outcomes and received less than adequate PNC compared to White women. Additionally, preliminary results suggest there are county differences in adverse birth outcomes and PNC utilization. The next two chapters present two papers: (1) Do both traditional and novel measures of county-level structural racism account for racial inequities seen in adverse birth outcomes among African American and White women? (3) Do county-level indicators of social and economic deprivation account for racial inequities seen in African American and White women's prenatal care utilization?

CHAPTER IV

TESTING THE ASSOCIATION BETWEEN TRADITIONAL AND NOVEL MEASURES OF COUNTY-LEVEL STRUCTURAL RACISM AND ADVERSE BIRTH OUTCOMES AMONG BLACK AND WHITE WOMEN

Brittany D. Chambers, Tracy R. Nichols, Jennifer Toller Erausquin, and Amanda E. Tanner

Abstract

The purpose of this study was to examine associations between both traditional and novel measures of county-level structural racism and adverse birth outcomes among Black and White women. We merged individual-level data from the California Birth Statistical Master Files 2009-2013 with county-level data from the US Census American Community Survey 2009-2013. We used random slopes hierarchical linear modeling to examine Black-White differences in the association between indicators of structural racism and two outcomes (infant birth weight and gestational age) among 531,170 primiparous women across 33 California counties. The average gestational age of singleton infants born was 38.6 weeks and 39.0 weeks for Black and White women, respectively. Black women birthed infants of lower average weight compared to White women. Multivariate analysis showed race remained significantly associated with birth weight and gestational age, adjusting for individual characteristics (e.g., health behaviors, pregnancy complications) and county-level poverty. In multilevel models, traditional approaches were associated with gestational age and birth weight and Black and White

women, while novel approaches were only associated with birth weight, controlling for individual characteristics and county-level poverty. There was a significant interaction between race and a traditional indicator of structural racism; county-level racial isolation was more strongly associated with earlier gestational age for Black women than for White women. Our initial findings confirmed those of prior studies showing race is associated with key birth outcomes. There was an interaction between individual-level race and a traditional measure of structural racism. Although novel county-level measures of structural racism were only associated birth weight, given the disparities in birth outcomes more work is needed to understand the causes.

Introduction

Despite decreases in infants born premature and at low-birth weight in the U.S., racial disparities continue. Black women are two to three times more likely to have infants born premature or at low-birth weight compared to White women (Hamilton et al., 2015; Nuru-Jeter et al., 2009). This is problematic since preterm birth and low-birth weight are the top two leading causes of infant mortality (Centers for Disease Control and Prevention [CDC], 2015a). Racial disparities in adverse birth outcomes between Black and White women are attributed to individual-level factors such as mothers' socioeconomic status (Braveman et al., 2015; Colen et al., 2006); health risks behaviors (e.g., smoking during pregnancy) (Beck et al., 2002; Ebrahim et al., 2000); experiences of stress (Giscombé & Lobel, 2005; Wadhwa et al., 2011); health complications during pregnancy (Heslehurst et al., 2008; Premkumar et al., 2016); and prenatal care utilization

(Partridge et al., 2012; Xaverius et al., 2016). Emerging research has explored exposure to structural racism during pregnancy and across the life-course as a factor associated with racial disparities in adverse birth outcomes, rendering promising results (Bell et al., 2006; Grady, 2006, 2010; Grady & Ramírez, 2008; Kramer et al., 2010; Mason et al., 2009; Messer et al., 2006; Wallace et al., 2015).

Structural racism is defined as systematic laws and processes used to allocate resources and opportunities to advantage Whites over Blacks in society (Massey & Denton, 1988, 1989). It is traditionally measured by residential segregation indices (i.e., dissimilarity, isolation, centralization, concentration, and clustering). The dissimilarity index measures the evenness of two social groups across a community's areal units (Massey & Denton, 1988). The isolation index measures exposure to a potential interaction or contact between two social group members within a community's areal units (Massey & Denton, 1988). The concentration index measures the amount of physical space one social group has across an areal unit (Massey & Denton, 1988). The centralization index measures the extent to which one social group is spatially located near the center of areal units (Massey & Denton, 1988). The clustering index measures the extent to which groups of people from one social group reside in adjoining areal units (Massey & Denton, 1988). Residential segregation indices aim to capture the aftermaths of enslavement of Africans through the use of collective action racism (i.e., institutionalized laws and legislation to separate Blacks from Whites) and centralized racism (i.e., an operative process used to maintain separation between Blacks and whites)

to geographically separate Blacks from Whites and allocate resources accordingly (Kramer & Hogue, 2009).

The relationship between structural racism and disparities in adverse birth outcomes varies across studies. At the community-level (with census tracts, census block groups, and metropolitan areas serving as the geographic scale), isolation, dissimilarity, deprivation, and crime rates are positively associated with adverse birth outcomes among Black women, after controlling for community poverty (Bell et al., 2006; Britton & Shin, 2013; Elo et al., 2009; Grady, 2006, 2010; Grady & Ramírez, 2008; Janevic et al., 2010; O'Campo et al., 2008). In contrast, residential segregation measured by racial clustering is associated with more optimal birth outcomes among Black women, specifically fewer incidents of low-birth weight and premature infants, after controlling for community poverty (Bell et al., 2006; Grady, 2010). There are also inconsistent results about the association of residential segregation with adverse birth outcomes for White women (Elo et al., 2009; Grady, 2006, 2010; Grady & Ramírez, 2008; Janevic et al., 2010; Kramer et al., 2010; Mason et al., 2009; O'Campo et al., 2008). For example, some studies have found that living in Black isolated neighborhoods increases the odds of adverse birth outcomes for both White and Black women (Elo et al., 2009; Mason et al., 2009; O'Campo et al., 2008), while others found racial disparities between Black and White women (Grady, 2006, 2010; Janevic et al., 2010; Kramer et al., 2010). Findings from these studies provide evidence that residential segregation may explain racial inequities in adverse birth outcomes above and beyond community poverty.

More recent research conceptualizes structural racism as operating beyond community contexts and may include local, state, and national laws as well as political infrastructures (e.g., state senate or county Board of Supervisors) and institutional (e.g., medical facilities) policies that negatively affect minority groups (Lukachko et al., 2014). Exposures to racism may operate differently by geographic scale (e.g., metropolitan statistical areas, census tracts, and county- and state-level), representing distinct patterns in the spatial distribution of racial groups including social context and health policies (Bird, 1995; Massey et al., 2009). In response to the potential of racism to operate differently across geographic scales, Lukachko and colleagues (2014) proposed using states as the geographic scale to measure novel indicators of structural racism across four domains: political participation, judicial treatment, educational attainment, and employment and job status.

Political participation and judicial treatment, in particular, align with causations of structural racism (Jones, 2001; Smedley & Smedley, 2005; West, 2002). Racism functions by developing and perpetuating a dominant cultural orientation of privilege and discrimination encompassing universal values, principles, and beliefs in institutions such as schools, churches, governments, and social service agencies, that often lack cultural and racial diversity (Graham et al., 2011). Lukachko et al.'s (2014) indicators of structural racism measure racial diversity in the dominant cultural orientation of privilege and discrimination by assessing the extent to which Black and White ratios in political participation, judicial treatment, educational attainment, and employment and job status are associated with health outcomes. In fact, state-level indicators of racism (i.e.,

employment and job status, educational attainment, and judicial treatment) have been shown to be associated with higher odds of infants being born small for gestational age (Wallace et al., 2015). However, it is currently unknown whether this novel approach to measuring structural racism, when scaled at the county-level, is associated with gestational age and birth weight. Understanding county-level influences on adverse birth outcomes could provide innovative ideas for where and how to intervene to reduce racial disparities and improve health outcomes.

Measuring structural racism at the county-level is plausible due to the uneven distribution of resources across counties (e.g., access to and availability of health care) and governance power to allocate resources (e.g., social and political context) (Bambhroliya et al., 2012; Gutnik & Castro, 2016; Hipp, 2015; Jia et al., 2009; Sommers et al., 2015). For example, in California, 24% of counties have the power to adopt and amend laws and regulations affecting the flow of resources and the diversity of county governance (California State Association of Counties, 2014). Only one study has assessed the association between county-level residential segregation (i.e., isolation and dissimilarity indices) and county distributions of preterm births (PTB) and infants born at low-birth weight (LBW) among African American women (Nyarko & Wehby, 2012). Nyarko and Wehby (2012) used quantile regression grouping counties average percentage of PTB and LBW among African American women in the following quantiles 0.1, 0.25, 0.5, 0.75 and 0.9 (Nyarko & Wehby, 2012). Findings showed as county-level dissimilarity and isolation increased, there was about a 10% increase in PTB and LBW to African American women among counties with the lowest prevalence of adverse birth

outcomes (i.e., quantile 0.1) compared to counties with higher prevalence of adverse birth outcomes (i.e., quantiles 0.75 and 0.9) (Nyarko & Wehby, 2012). There are currently no studies focused on the relationship between county-level residential segregation and women's individual adverse birth outcomes.

Given the need to better understand the mechanisms by which racism affects birth outcomes, the purpose of this study was to examine associations between both traditional and novel measures of county-level structural racism with adverse birth outcomes among Black and White women residing in California. We used Krieger's (1994, 2012) conceptualization of ecosocial theory to frame these analyses and acknowledge race and race relations systematically advantage Whites over Blacks in the U.S. American society, generating "inequitable living and working conditions that, via embodiment, result in the biological expression of racism—and hence racial/ethnic health inequities" (Krieger, 2012, p. 937). This study centered on Black and White women's exposures to structural racism at the county-level to better understand long-standing embodied racial inequities in adverse birth outcomes. We hypothesized that county-level indicators of structural racism would be significantly associated with adverse birth outcomes, and at a higher magnitude for Black women compared to White women.

Methods

Data. We analyzed data from the California Birth Statistical Master Files for years 2009-2013. These data are cross-sectional records for the corresponding years, with information obtained from birth certificates. This dataset represents the most comprehensive and largest available birth data nationwide and includes maternal,

parental, and infant characteristics, as well as medical information (e.g., preeclampsia, STI infections) pertaining to the birth. Geographic information related to the mother's place of residence during birth such as census tract, state, county, and zip code level are provided. This allowed us to link the birth record data to contextual information from the U.S. Census American Community Survey (2009-2013) and to conduct multilevel analyses to better understand associations of individual- and county-level factors with racial disparities in birth outcomes.

Study Sample. This study focused on non-Hispanic Black and White women who gave birth during 2009-2013 and reported California as their place of residence. Individual-level exclusion criteria included women who had previous births or pregnancy terminations, multiples (e.g., twins and triplets), gave birth to infants less 500 or greater than 6,000 grams, pregnancies ended before 21 weeks, pregnancies extended post 43 weeks (Bell et al., 2006), and who were missing data on individual-level variables of interest (n = 664,830). Women included in this study were less likely to identify as White, be of an older age, use public insurance, have pregnancy complications, and have adverse birth outcomes compared to women excluded from the study (see Table 3).

County-level inclusion criteria included counties with population sizes 100,000 or greater and counties with at least 50 live births to Black women for the study time period (Nyarko & Wehby, 2012). Therefore, this study was limited to 33 of the 58 counties within California (n=30,191). The final sample size was 531,170 non-Hispanic Black and White women.

Measures. The outcome variables were gestational age and birth weight. Gestational age was measured in weeks ranging from 21-42, and birth weight was measured in grams ranging from 501-5993.

Individual-level predictor variables included mother's race, age, complications during pregnancy, insurance, cigarette use during pregnancy, and prenatal care utilization. Individual-level variables were retrieved from women's birth certificate records, detailed demographic information, and medical files related to the birth event. Mother's race was denoted by non-Hispanic Black or White only. Women who reported multiple racial groups were excluded from the study. Age was a continuous variable. Complications during pregnancy were measured by two dichotomous variables: diabetes (i.e., before and/or during pregnancy) and hypertension (i.e., before and/or during pregnancy). Insurance used during pregnancy was measured by three dichotomous variables: private, public, or self-pay. Cigarette use during pregnancy was measured by any cigarette used across the three trimesters vs. no cigarette use during pregnancy. Prenatal care utilization was measured by Kotelchuck (1994) Adequacy of Prenatal Care Utilization Index (APCU Index), classifying care as Adequate (Adequate/Adequate Plus) versus Less than Adequate (Intermediate/Inadequate). Mother's age, pregnancy complications, insurance status, cigarette use, and prenatal care utilization served as control variables due to their association with adverse birth outcomes (Beck et al., 2002; Braveman et al., 2015; Partridge et al., 2012; Premkumar et al., 2016).

County-level predictor variables were traditional and novel approaches to measure structural racism. Table 8 provides a description of county-level indicators of

structural racism used in this study. Traditional approaches to measuring indicators of structural racism are residential segregation indices. This study focused on evenness, exposure, and concentration indices. Given the tremendous racial inequities between Black and White people in wealth, credit, educational attainment, employment, income, and rates of incarceration, this study measured novel county-level indicators of structural racism across two domains: political participation and judicial treatment.

County-level poverty served as a control variable due to community-level poverty's association with adverse birth outcomes (Brumberg & Shah, 2015; Wallace et al., 2013). Furthermore, scholars argue that indicators of structural racism are associated with adverse birth outcomes, even after accounting for community poverty (Bell et al., 2006; Grady, 2010). Therefore, this study measured poverty by the proportion of all persons living below the federal poverty line at the county-level.

Statistical Analysis. Descriptive statistics and bivariate analyses (i.e., t- and chi-square tests) were conducted for all individual- and county-level variables. Hierarchical linear modeling was used to assess how county-level indicators of structural racism were associated with women's adverse birth outcomes. Random slopes hierarchical linear modeling was used to account for cross-level differences between Black and White women and indicators of structural racism.

Preliminary analyses revealed that infant birth weight (intra-class correlation = 0.007; $p < 0.001$) and gestational age (intra-class correlation = 0.008; $p < 0.001$) significantly varied across counties, providing justification for the use of hierarchical linear modeling. We used a step-wise approach to assess if indicators of structural racism

explained additional variation in racial disparities seen in adverse birth outcomes between Black and White women, thus accounting for both county-level poverty and individual-level maternal characteristics and behaviors, insurance, pregnancy complications, and PNC utilization. Model 1 included racial status as the only level-1 predictor variable accounting for individual-level control variables and county variability (via random intercept). Model 2 added county-level poverty as the only level-2 predictor. Models 3-7 added to the prior models by also included each indicator of structural racism, separately as level-2 predictors. Finally, Models 8-10 used random slope modeling to assess cross-level interactions between individual-level race and county-level indicators of structural racism in predicting adverse birth outcomes. All models were adjusted for maternal characteristics and behaviors, insurance, pregnancy complications, PNC utilization, and county variability. All statistical analyses were conducted in HLM version 7. Intra-class correlations and proportion of variance explained were calculated in Microsoft Excel 2010.

Results

Maternal and County-Level Characteristics. Table 9 summarizes maternal characteristics. Among the 531,170 women included in this study, about 17% (n = 88,815) identified as Black and 83% as White (n = 442,355). The average age of women in the sample was 29.1. The majority of women used private insurance during prenatal care (64.6%) and received adequate PNC (72.2%). Relatively few women reported cigarette use (3.8%) or complications during pregnancy (diabetes 3.4%; hypertension 3.5%). The average gestational age and birth weight of infants born to women in this

study was 38.9 weeks (*wks*) and 3382.6 grams (*g*), respectively. Approximately 6% of women had preterm births and 4.5% had infants born at low-birth weight.

There were racial differences in individual characteristics, health behaviors, complications during pregnancy, prenatal care utilization, and birth outcomes (see Table 9). On average, Black women were younger than White women (M = 26.3 vs. 29.6). Black women were also more likely to use public insurance during pregnancy (20.3% vs. 11.0%) and to receive less than adequate PNC (36.0% vs. 26.2%) compared to White women. Higher proportions of White women reported cigarette use (3.8% vs. 3.6%) and diabetes complications (3.4% vs. 3.1%) before and/or during pregnancy. Black women were more likely to be hypertensive before and/or during pregnancy compared to White women (4.4% vs. 3.3%). On average, Black women's infants had earlier gestational ages (M = 38.6 *wks* vs. 39.0 *wks*) and lower birth weights (M = 3190.3 *g* vs. 3421.2 *g*) compared to White women.

Table 10 displays descriptive statistics for county-level variables. On average, 17% of persons living in counties across California lived below the federal poverty line. On average, counties reported low isolation (M= 0.25), moderate dissimilarity (M= 0.49), and high concentration (M = 0.80). The mean for political participation was under 1, suggesting Blacks are underrepresented in board of supervisor positions. For example, on average for every one Black person across counties, there were 11 White persons who served in board of supervisor positions. In contrast, Blacks were overrepresented in prisons across counties in California at 1.09 times that of Whites.

County-level poverty and traditional and novel indicators of structural racism were statistically associated with adverse birth outcomes (see Table 7). County-level poverty was significantly associated with infants' birth weight (β = -380.97 *g*, $p < 0.01$) and gestational age (β = -1.76 *g*, $p < 0.01$). County-level isolation was significantly associated with birth weight (β = -157.81 *g*, $p < 0.01$) and gestational age (β = -0.32 *g*, $p < 0.05$), while concentration was related to gestational age (β = -0.66 *g*, $p < 0.05$). Racial inequities in board of supervisor positions were related to gestational age (β = 0.14 *g*, $p < 0.05$), while inequities in incarceration were significantly associated with infants' birth weight (β = -12.15 *g*, $p < 0.05$). County-level dissimilarity was not significantly associated with infants' birth weight (β = -142.27 *g*, $p = 0.23$) or gestational age (β = 0.02 *g*, $p = 0.95$).

Multivariate Results: The Association of Individual- and County-Level Characteristics with Adverse Birth Outcomes. Results of hierarchical linear models predicting infant birth weight are shown in Table 11. Model 1 reveals that racial status is negatively associated with infant birth weight, when controlling for maternal characteristics and behaviors, insurance, pregnancy complications, PNC utilization, and county variability (Model 1; β = -207.36 *g*, $p < 0.01$). The addition of county-level poverty in Model 2 shows there is a statistically significant relationship between county-level poverty and infant birth weight. As county-level poverty increases, infants' weight decreases by 209.03 grams. However, racial status remains a significant contributor (Model 2; β = -209.03 *g*, $p < 0.01$). The addition of county-level poverty slightly changes the intra-class correlation and proportion of variance explained.

Table 8. Description of County-Level Indicators of Structural Racism (Paper 1)

Indicators of Structural Racism	Measure	Description	Data Source (Date)
Traditional			
Evenness	Dissimilarity Index	$D = \frac{1}{2}\sum_{i=1}^{n}\left[\frac{x_i}{X} - \frac{w_i}{W}\right]$, the proportion of African Americans that would have to change their place of residence to achieve an even distribution of Whites and African Americans in the county. Scores range from 0 (complete integration) to 1 (complete segregation).	American Community Survey. U.S. Census (2009-2013)
Exposure	Isolation Index	$xPx^{*} = \sum_{i=1}^{n}\left[\left(\frac{x_i}{X}\right)\left(\frac{x_i}{t_i}\right)\right]$, the probability that an African American will reside in the same sub-area within a county as another African American. Scores range from 0 (complete integration) to 1 (complete segregation).	American Community Survey. U.S. Census (2009-2013)
Concentration	Delta Index	$Del = \frac{1}{2}\sum_{i=1}^{n}\left[\frac{x_i}{X} - \frac{a_i}{A}\right]$, the proportion of African Americans that would have to change their place of residence to achieve uniform density of African Americans across a county. Scores range from 0 (complete integration) to 1 (complete segregation).	American Community Survey. U.S. Census (2009-2013)
Novel			
Judicial treatment	Felony incarcerations	Ratio of Black/White at the county-level who are incarcerated for a felony.	Center on Juvenile and Criminal Justice (2012)
Political participation	County board of supervisors	Ratio of Black/Whites who were elected as county board of supervisors	County board of supervisors websites (2016)
Notation: x_i = total African Americans in a census tract w_i = total Whites in a census tract t_i = total population (African Americans + Whites) in a census tract a_i = total land area in a census tract X = total African Americans in a county W = total Whites in a county A = total land area in a county			

Table 12 displays the results of hierarchical linear models predicting gestational age. Model 1 shows that being a Black woman, in comparison to a White woman, is significantly associated with an earlier gestational age (Model 1; β = -0.35 *wks*, $p < 0.01$), accounting for maternal characteristics and behaviors, insurance, pregnancy complications, PNC utilization, and county variability. The addition of county-level poverty in Model 2 shows that county-level poverty is significantly associated with gestational age, reducing the intra-class correlation and explaining 22% of the variation in gestational age. County-level poverty magnified a suppressed relationship between racial status and gestational age, where being a Black woman was associated with birthing infants nearly two weeks earlier than White women, compared to about three days earlier in Model 1.

Traditional Indicators of Structural Racism. Among traditional county-level indicators of structural racism, dissimilarity and isolation were associated with birth weight, accounting for maternal characteristics and behaviors, insurance, pregnancy complications, PNC utilization, and county-level poverty (see Table 12). Higher levels of county-level dissimilarity (Model 3; β = -187.31 *g*, $p < 0.05$) and isolation (Model 4; β = -110.20 *g*, $p < 0.01$) were each associated with women Black and White women having infants of lower birth weight. The addition of the dissimilarity and isolation indices reduced the intra-class correlation, and explained 7% and 10% more variation in birth weight, respectively. Only county-level isolation was associated with earlier gestational age among Black and White women, after controlling for maternal characteristics

Table 9. Individual Characteristics and Birth Outcomes for African American and White Primiparous Women, California Birth Statistical Master Files 2009-2013 (N = 531,170) (Paper1)

	White	African American	Total
Individual Characteristics	**(n = 442,355)**	**(n=88,815)**	**(N = 531,170)**
	mean (SD)	mean (SD)	mean (SD)
Age**	29.6 (5.653)	26. 31 (6.205)	29.05 (5.879)
	% (n)	% (n)	% (n)
Insurance**			
Private	70.6 (312204)	34.5 (30671)	64.6 (342875)
Public	11.0 (48621)	20.3 (17997)	32.8 (174364)
Self-Pay	3.5 (15515)	4.0 (3523)	3.6 (19038)
Cigarette use during pregnancy*			
No	96.2 (425608)	96.4 (85595)	96.2 (511203)
Yes	3.8 (16747)	3.6 (3220)	3.8 (19967)
Complications during pregnancy			
Diabetes**	3.4 (15219)	3.1 (2746)	3.4 (17965)
Hypertension**	3.3 (14624)	4.4 (3908)	3.5 (18532)
Prenatal Care Utilization**			
Adequate	73.8 (326439)	64.0 (56817)	72.2 (147914)
Less than Adequate	26.2 (115916)	36.0 (31998)	27.8 (531170)
Gestational Age (mean)**	38.99 (1.622)	38.61 (2.101)	38.92 (1.717)
Full-term (> 37 weeks)	94.7 (418847)	91.1 (80941)	94.1 (499788)
Pre-term (<37 weeks)	5.3 (23508)	8.9 (7874)	5.9 (31382)
Birth Weight (mean)**	3421.24 (511.416)	3190.26 (571.106)	528.941 (3382.62)
Normal birth weight (> 2,500 grams)	96.4 (426390)	91.3 (81097)	95.5 (507487)
Low birth weight (< 2,5000 grams)	3.6 (15965)	8.8 (7718)	4.5 (23683)

Note: Racial differences in means (i.e., age) were assessed using ANOVA. Race differences for categorical variables (i.e., insurance, cigarette use, pregnancy complications, and PNC) were assessed using Chi-square analysis. ** = p-value < 0.01, * = p-value < 0.05.

Table 10. County Characteristics, U.S. Census American Community Survey 2009-2013 (N = 33) (Paper 1)

County-level variables	Mean	Std. Deviation	Range
Poverty			
Living below the federal poverty level	0.17	0.06	0.08-0.27
Indicators of structural racism			
Residential Segregation			
Dissimilarity	0.49	0.07	0.35-0.68
Isolation	0.25	0.16	0.02-0.64
Concentration	0.80	0.08	0.56-0.93
Political Participation			
Board of supervisors	0.09	0.22	0.00-1.00
Judicial treatment			
Incarceration	1.09	1.39	0.09-7.10

and behaviors, insurance, pregnancy complications, PNC utilization, and county-level poverty and variability (Table 12; Model 4; β = -0.37 *wks*, $p < 0.01$). The addition of the isolation index did not explain more variation in gestational age, compared to county-level poverty. County-level concentration was not significantly associated with birth weight or gestational age. Across all models, racial status and county-level poverty remained significant predictors of birth weight and gestational age.

Table 13 shows cross-level interactions between race and traditional county-level indicators of structural racism, adjusting for maternal characteristics and behaviors, insurance, pregnancy complications, PNC utilization, and county variability. Only the interaction between race and county-level isolation was significantly associated with gestational age. Black women who lived in counties with higher isolation birthed infants at earlier gestational ages, in comparison to White women who lived in counties with

higher isolation (Model 10; β = -0.35 *wks*, $p < 0.05$). Accounting for the interaction effect between racial status and county-level isolation reduced the intra-class correlation and explained 2% more variation in gestational age than county-level poverty.

Novel Indicators of Structural Racism. Novel approaches to measuring structural racism were only associated with birth weight (see Tables 10). As the Black to White ratio in county-level incarceration increased, infants' birth weight decreased by 7.80 grams among Black and White women ($p < 0.05$). Yet, as county-level board of supervisor positions reached racial equity, infants' birth weight decreased by 37.64 grams among Black and White women ($p < 0.01$). The addition of novel approaches to measuring county-level structural racism reduced the intra-class correlation and explained about 3% more variation in birth weight than county-level poverty. There were no statistically significant interactions between novel indicators of structural racism and race (data not provided).

Discussion

To our knowledge, this was the first study to assess the association of both traditional and novel approaches to measuring indicators of structural racism at the county-level with women's individual adverse birth outcomes. Surprisingly, the significant association between county-level racial concentration and gestational age became non-significant after accounting for individual characteristics and county-level poverty. This may be due to high-levels of areal concentration (the measurement of the proportion of Blacks that would have to change their place of residence to achieve

uniform density of Blacks across a county). However, given that other residential segregation indices (e.g., county-level dissimilarity and isolation) were significantly associated with women's adverse birth outcomes, while accounting for individual characteristics and county-level poverty, our findings do support the importance of traditional approaches to measuring county-level indicators of structural racism to understand adverse birth outcomes experienced by both Black and White women. Our findings also support the utility of traditional indicators in explaining racial disparities in adverse birth outcomes. For example, our findings support Black women who live in counties with high isolation (the measurement of the probability that a Black person will reside in the same sub-area within a county as another Black person) birth infants at earlier gestation ages, which has implications for reducing racial inequities (Bell et al., 2006; Britton & Shin, 2013; Debbink & Bader, 2011; Grady, 2006; Kramer et al., 2010; Mason et al., 2009; Nyarko & Wehby, 2012). Even though the interaction of race and county-level isolation explained more variation racial disparities in gestational age than individual-level factors and county poverty alone, race remained a significant predictor. These findings suggest a need to continue to search for and develop more comprehensive approaches to measure county-level indicators of structural racism.

Novel approaches to measuring county-level indicators of structural racism added to our understanding of disparities in infants' birth weight among Black and White women. Racial inequities in county-level boards of supervisors and incarceration were significantly associated with birth weight among both African American and White

women (Wallace et al., 2015), suggesting county-level structural racism is detrimental to the health and well-being of Black and White infants.. Findings from this study indicate these novel approaches to measuring indicators of structural racism at the county-level do not explain variation in infants' gestational age. Future studies should explore different approaches to measuring indicators of structural racism at the county-level. This is particularly true for counties in California as they have the ability to regulate the flow of resources as well as the diversity of county governance, thereby impacting the accessibility of resources and health of county constituents.

Given the profound effect of county-level poverty on adverse birth outcomes, we believe poverty and indicators of structural racism may be measuring overlapping forms of oppression (Acevedo-Garcia et al., 2003; Wallace et al., 2015). For example, research suggests increases in community poverty can be attributed to high racial segregation (Acevedo-Garcia et al., 2003). Future studies should examine the collective impact poverty and indicators of structural racism may have on adverse birth outcomes among Black and White women.

Limitations

Although lower percentages of Black women in this study reported preterm births and low-birth weight infants compared to the U.S. and California as a whole, there were similar inequity gaps between Black and White women. However, the lower percentages of adverse birth outcomes found among women in this study were expected due to the study's exclusion criteria procedures. Therefore, women in this study represent those who

are at lowest risk for having adverse birth outcomes. Second, this study used cross-sectional data and as a result, cannot assess life-course exposure to racism or causality. Nonetheless, findings from this study provided a snapshot of the impact of exposure to racism on adverse birth outcomes and can be used to conduct further research using longitudinal datasets to assess the cumulative effect of exposures to structural racism across the life-course. Additionally, this study used novel approaches to measure structural racism initially proposed by Lukachko and colleagues (2014) to be used at the state-level. Due to this study changing the geographic scale from states to counties within California, we were unable to include all measurements of political participation (i.e., registered to vote and voted) and judicial treatment (i.e., disenfranchised and death row). Furthermore, findings from this study suggest measuring novel approaches to structural racism at the county-level were only associated with birth weight.

Conclusion

Findings from this study highlight the importance of traditional approaches to measuring indicators of structural racism at the county-level in understanding racial disparities in adverse birth outcomes between Black and White women residing in California. Traditional approaches to measuring indicators of structural racism, particularly the isolation index, negatively impact infants born to Black women, putting them at increased risk for prematurity. This suggests that exposures to residential segregation become *embodied* and contribute to racial disparities in gestational age between Black and White women.

County-level novel approaches to measure indicators of structural racism were only associated with birth weight for both Black and White women. Findings from this study also suggest the need to develop more innovative approaches to measure county-level indicators of structural racism such as racial inequities in policing, given the American Public Health Association's (APHA) policy statement identifying law enforcement violence as a public health issue (APHA, 2016). Furthermore, findings from this study call for a need for policy reformation at the county-level to increase integration and access to resources.

Table 11. Estimates of Associations between Race, and County-Level Poverty and Indicators for Structural Racism with Birth Weight (Paper 1)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Fixed Effect							
Intercept	3312.45**	3348.12**	3455.15**	3386.78**	3356.75**	3369.23**	3361.28**
Individual Factors							
Race							
Black (White as referent)	-207.36**	-209.03**	-209.27**	-208.70**	-208.98**	-208.49**	-208.81**
County Factors							
Poverty	--	-209.08*	-294.35**	-277.64**	-202.40*	-247.95**	-261.05**
Structural Racism							
Traditional							
Dissimilarity	--	--	-187.31*	--	--	--	--
Isolation	--	--	--	-110.20**	--	--	--
Concentration	--	--	--	--	-12.15	--	--
Novel							
Incarceration	--	--	--	--	--	-7.80*	--
Board of Supervisors	--	--	--	--	--	--	-37.64**
Random Effect							
Residual	266917.07	266917.30	266917.48	266917.55	266917.30	266917.20	266917.35
Intercept	1056.12**	1041.61**	909.82**	878.61**	1075.57**	959.91**	963.52**
Black, Slope	1684.84**	1660.58**	1651.47**	1629.05**	1659.87**	1668.84**	1652.36**
Model Comparison Statistics							
Chi-square Statistic	-	535.92**	535.91**	535.91**	535.92**	535.92**	1620.98
Degrees of Freedom	-	32	32	32	32	32	30
Intra-class correlation	0.0041	0.0040	0.0035	0.0033	0.0042	0.0037	0.0037
Proportion of variance explained	0.4809	0.4835	0.5530	0.5754	0.4668	0.5247	0.5247

Note: *=<.05, **=<.01. All models were controlled for age, insurance, and complications during pregnancy, cigarette use, and prenatal care utilization.

Table 12. Estimates of Associations between Race, and County-level Poverty and Indicators for Structural Racism with Gestational Age (Paper 1)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Fixed Effect							
Intercept	39.09**	39.45**	39.64**	39.53**	39.54**	39.45**	39.41**
Individual Factors							
Race (White as Referent)							
Black	-0.35**	-0.36**	-0.36**	-0.35**	-0.36**	-0.36**	-0.36**
County Factors							
Poverty	--	-1.98**	-2.13**	-2.05**	-1.88**	-2.03**	-1.90**
Structural Racism							
Traditional							
Dissimilarity	--	--	-0.36	--	--	--	--
Isolation	--	--	--	-0.36**	--	--	--
Concentration	--	--	--	--	-0.16	--	--
Novel							
Incarceration	--	--	--	--	--	-0.01	--
Board of Supervisors	--	--	--	--	--	--	0.04
Random Effect							
Residual	2.83	2.83	2.83	2.83	2.83	2.83	2.83
Intercept	0.03**	0.02**	0.02**	0.02**	0.02**	0.02**	0.02**
Black, Slope	0.01**	0.01**	0.01**	0.01**	0.01**	0.01**	0.01**
Model Comparison Statistics							
Chi-square Statistic	-	2456.12**	2456.11**	2456.10**	2456.13**	2456.11**	2456.12**
Degrees of Freedom	-	32	32	32	32	32	32
Intra-class correlation	0.0097	0.0063	0.0066	0.0064	0.0063	0.0066	0.0063
Proportion of variance explained	0.000	0.2170	0.1751	0.1992	0.2132	0.1759	0.2136

Note: *=<.05, **=<.01. All models were controlled for age, insurance, and complications during pregnancy, cigarette use, and prenatal care utilization.

Table 13. Estimates of Associations between Interactions between Race and Indicators for Structural Racism with Birth Outcomes (Paper 1)

	Birth Weight		Gestational Age
	Model 8	**Model 9**	**Model 10**
Fixed Effect			
Intercept	3458.69**	3380.72**	39.48**
Individual Factors			
Race			
White (Referent)	Ref.	Ref.	Ref.
Black	-224.13**	-191.40**	-0.25**
County Factors			
Poverty	-296.12**	-266.06**	-2.02**
Structural Racism			
Traditional			
Dissimilarity	-193.86*	--	--
Isolation	--	-93.50**	-0.18
Interactions			
Dissimilarity*Race			
Dissimilarity*White (Referent)	Ref.	Ref.	Ref.
Dissimilarity*Black	29.48	--	--
Isolation*Race			
Isolation*White (Referent)	Ref.	Ref.	Ref.
Isolation*Black	--	-57.06	-0.35*
Random Effect			
Residual	266917.57	266917.20	2.83
Intercept	913.75**	868.32**	0.02**
Black, Slope	1717.07**	1618.68**	0.01**
Model Comparison Statistics			
Chi-square Statistics	535.90	535.91	2456.10
Degrees of Freedom	32	32	32
Intra-class correlation	0.0035	0.0033	0.0061
Proportion of variance explained	0.5511	0.5785	0.2359

Note: *=<.05, **=<.01. All models were controlled for age, insurance, and complications during pregnancy, cigarette use, and prenatal care utilization.

CHAPTER V

EXAMINING THE ASSOCIATION OF COUNTY-LEVEL SOCIAL AND ECONOMIC DEPRIVATION ON AFRICAN AMERICAN AND WHITE WOMEN'S PRENATAL CARE UTILIZATION

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Abstract

This study examined the extent to which county-level indicators of social and economic deprivation helped to explained racial inequities in prenatal care (PNC) utilization between African American and White women. This study merged cross-sectional datasets (i.e., California Birth Statistical Master Files 2009-2013) with county-level data (US Census American Community Survey 2009-2013) for 531,170 African American and White women residing in 33 counties across California. Random slope hierarchical logistic modeling was used to examine cross-level associations between race and indicators of social and economic deprivation. HLM version 7 was used to conduct the statistical analyses. Racial status (i.e., African American) was a significant predictor for receiving less than adequate PNC, accounting for individual characteristics and county-level poverty. Results indicated that increases in the county-level African American to White ratio in professional jobs significantly increased the likelihood of both African American and White women receiving less than adequate PNC, but did not significantly reduce the racial inequity gap between African American and White women

in overall PNC utilization. Although PNC has mixed effects on reducing inequities in birth outcomes, it serves as a proxy for access to health care and may have immediate and long-term consequences on the health of women, infants, and children. Our results highlight the complexity of women's lives, particularly African American women, supporting individual and contextual factors as important to understanding racial disparities in PNC utilization. Future research should explore more comprehensive ways to measure social and economic deprivation, which accounts for the unique nuances of being an African American woman.

Introduction

Racial inequities in adverse birth outcomes (e.g., preterm birth (PTB) and low-birth weight (LBW)) between African American and White women persist in the United States (U.S.). For example, African American women are two to three times more likely to have PTB or LBW infants compared to White women (Hamilton et al., 2015; Nuru-Jeter et al., 2009). Adequate prenatal care (PNC) utilization (i.e., initiation of prenatal care between the first or fourth month of pregnancy and attended between 80% to 109% of recommended visits) has been identified as an effective tool to reduce adverse birth outcomes as it can result in early detection of health complications and diagnoses for mother and infant by providing women access to healthcare, educational and nutritional support, and social services (Centers for Disease Control and Prevention [CDC], 2011; Healthy People [HP] 2020, 2016; Kotelchuck, 1994; Shiono & Behrman, 1995). Some studies have found that no or inadequate PNC is a significant predictor of infant

mortality, PTB, and LBW among African American women (Collins et al., 2006; Cox et al., 2011). Other studies have found that despite increases in adequate PNC utilization, racial inequities in adverse birth outcomes continue (Collins & David, 2009; Collins et al., 1997). Thus, more work is needed to understand the complex association between factors affecting PNC utilization and adverse birth outcomes.

In the U.S., trends in PNC utilization have remained steady since 2000 (March of Dimes [MOD], 2017). Approximately 74% of women received adequate care, with 25.3% of women receiving less than adequate PNC (MOD, 2017). Racial disparities exist in adequate PNC utilization, where higher percentages of White women (79.1%) received adequate PNC compared to African American women (67.6%) (MOD, 2017). Similar trends and racial inequities in PNC utilization are reported among women residing in California, with 21% of women reporting receiving less than adequate care (White women 72.5% and African American women 82.1%) (MOD, 2017).

Inequities in PNC utilization are associated with individual and structural factors. African American women who are younger and use alcohol or drugs during pregnancy were more likely to receive no or inadequate PNC compared to White women (D'Angelo, Bryan, & Kurz, 2016; Frisbie et al., 2001; Johnson et al., 2007; Partridge et al., 2012; Roberts & Nuru-Jeter, 2010; York et al., 1999). Studies have also shown a relationship between no or inadequate PNC among African American women and racial discrimination from clinical providers and staff in healthcare settings (Slaughter-Acey et al., 2013; Ward et al., 2013). Structural factors such as accessibility to healthcare services, including PNC, continue to be an issue for African American women in the U.S.

African American women are more likely to lack access to resources such as private healthcare insurance and transportation compared to White women, contributing to the racial inequities seen in PNC utilization and adverse birth outcomes (Baffour & Chonody, 2009; Bengiamin et al., 2010; Phillippi, 2009).

Although higher proportions of African American women receive inadequate PNC, there are conflicting results on the extent to which receiving adequate PNC reduces racial inequities in adverse birth outcomes. Thus, more attention has been geared towards assessing the association between community-level socioeconomic context and inequities in adverse birth outcomes (Bastek et al., 2015; Elo et al., 2009; Janevic et al., 2010; Ncube, Enquobahrie, Albert, Herrick, & Burke, 2016; O'Campo et al., 2008). However, only two studies focused on the association between community-level socioeconomic context and PNC utilization (Cubbin et al., 2008; Perloff & Jaffee, 1999). Cubbin and colleagues (2008) found that race moderated the association between socioeconomic context and PNC utilization when adjusting for individual-level socioeconomic characteristics. African American women living in low-deprivation communities (i.e., lower proportions of crowded housing, unemployed persons, rented housing, and housing with no motor vehicle) were more likely to initiate late or no PNC than African American women from moderate-deprivation communities. White women, on the other hand, were more likely to initiate late or no PNC when living in high-deprivation communities (i.e., higher proportions of crowded housing, unemployed persons, rented housing, and housing with no motor vehicle) as compared to White women from moderate-deprivation communities. In contrast, Perloff and Jaffee (1999) found no association between

distressed communities (i.e., low economic opportunity) and late initiation of PNC among a predominately White sample. This indicates that race may moderate community associations with adverse birth outcomes, and suggests additional research should examine this question.

The limited research on structural indicators of social and economic deprivation provides evidence that racial inequity in PNC utilization continues despite access to community resources (Cubbin et al., 2008; Perloff & Jaffee, 1999), suggesting that novel approaches to measure community-level social and economic deprivation are needed to better understand the relationship. Investigating the association between structural indicators of social and economic deprivation and PNC utilization is important due to the policy implications and community-level interventions these data can inform (Cubbin et al., 2008).

The most common areal units used to assess the association between community context with adverse birth outcomes and PNC utilization are metropolitan statistical areas, census block groups, and census tracts (Bastek et al., 2015; Cubbin et al., 2008; Ncube et al., 2016; Perloff & Jaffee, 1999). A growing body of literature has used counties as the unit of analysis due to the potential for uneven distribution of resources across counties. Counties have been found to vary in the degree of access to and availability of healthcare as well as governance power to allocate resources and their social and political context (Bambhroliya et al., 2012; Gutnik & Castro, 2016; Hipp, 2015; Jia et al., 2009; Sommers et al., 2015). Associations between county-level indicators of social and economic deprivation and PNC utilization remain unknown.

Given the current gaps in the literature, this study assessed the extent to which county-level indicators of social and economic deprivation accounted for racial inequities between African American and White women's PNC utilization. We hypothesized that county-level indicators of social and economic deprivation will be negatively associated with PNC utilization, and at a higher magnitude for African American women compared to White women. This study was guided by the ecosocial theory (Krieger, 1994, 2012), recognizing the role individual- (e.g., race, insurance status) and community- (e.g., county-level job status) level social and economic conditions play in racial inequities seen in inadequate medical care (i.e., PNC utilization). Previous research highlights the importance of individual-level socioeconomic characteristics such as income and insurance status in understanding PNC utilization (Baffour & Chonody, 2009; Bengiamin et al., 2010; Phillippi, 2009). However, the extent to which community-level social and economic context is associated with racial inequities in PNC utilization remains inconclusive (Cubbin et al., 2008; Perloff & Jaffee, 1999). To our knowledge, this is the first study to assess if there is an association between individual- and county-level indicators of social and economic deprivation and African American and White women's PNC utilization. Findings from this study can be used to inform multilevel interventions to reduce racial inequities seen in PNC utilization.

Material and Methods

Data Collection. This study used the California Birth Statistical Master Files for years 2009-2013. The data are cross-sectional and represent women's births for the corresponding time points, with information obtained from birth certificates. This dataset

represents the most comprehensive and largest available birth data in the US and includes maternal, paternal, and infant characteristics, as well as medical conditions (e.g., preeclampsia, STI infections) pertaining to the birth. Geographic information related to the mother's county of residence during pregnancy and birth was used to merge county-level data on indicators of social and economic deprivation from the U.S. Census American Community Survey (2009-2013). This study was deemed exempt by the Institutional Review Board at the University of North Carolina, Greensboro.

Study Participants. This analysis focused on non-Hispanic African American and White women who gave birth during 2009-2013 and reported California as their place of residence. Individual-level exclusion criteria included women who had previous births or pregnancy terminations, multiples (e.g., twins and triplets), given birth to infants less than 500 and greater than 6,000 grams, pregnancies ended before 21 weeks, and pregnancies extended post 43 weeks due to these factors being highly associated with adverse birth outcomes (Bell et al., 2006). Approximately 8% of participants were excluded from the study due to missing data on individual-level variables.

County-level inclusion criteria included counties with population sizes 100,000 or greater and counties with at least 50 live births to African American women for the study time period, in order to avoid biases in estimating the inequalities in social and economic due to counties having low African-American representation (Nyarko & Wehby, 2012). Therefore, this study was limited to 33 of the 58 counties within California. The final sample size was 531,170 non-Hispanic African American and White women. Women in the final sample were more likely to be African American, of younger age, have private

insurance, fewer complications during pregnancy (e.g., diabetes and hypertension), and to receive less than adequate PNC compared to women were excluded from the study (see Table 3).

Measures. The outcome variable was PNC utilization and was measured using Kotelchuck's (1994) Adequacy of PNC Utilization Index (APCU Index). The APCU Index combines two separate measures of PNC utilization, PNC initiation and the number of visits attended while accounting for the gestational age of infants' at birth. The APCU Index classifies care as: inadequate (i.e., initiation of prenatal after 4 months or attended less than 50% of recommended visits), intermediate (i.e., initiation of prenatal between the first or fourth month of pregnancy and attended between 50% to 79% of recommended visits), adequate (i.e., initiation of prenatal between the first or fourth month of pregnancy and attended between 80% to 109% of recommended visits, capturing pregnancies exceeding 40 weeks), and adequate plus (i.e., initiation of prenatal between the first or fourth month of pregnancy and attended 110% of recommended visits). Each category is adjusted according to gestational age, thus accounting for preterm births. This variable was dichotomized to Adequate (i.e., Adequate/Adequate Plus) versus Less than Adequate (Intermediate/Inadequate) to assess how county-level social and economic deprivation is associated with women receiving less than adequate PNC.

There were eight individual-level predictor variables. They included mother's race (i.e., African American or White), age, complications during pregnancy (i.e.,

diabetes and hypertension), cigarette use, and insurance used during pregnancy (i.e., private, public, or self-pay).

County-level predictor variables included county-level measures of social and economic deprivation gathered from the U.S. Census American Community Survey (2009-2013). *Poverty* was measured by the proportion of all persons in the county living below the federal poverty line. *Job status* was measured by two items: the African American to White ratio among those who are in executive managerial positions, and the African American/White ratio for professional specialties. *Educational attainment* was measured by one item: the African American/White ratio among those who have a bachelor's degree or higher. *Job status* and *educational attainment* measures were multiplied by 100 to represent the number of African Americans who have professional and/or management jobs, and a bachelor's degree or higher for every 100 Whites in the county for the same indicators.

Data Analysis. Descriptive and bivariate statistics were conducted for all individual- and county-level variables in SPSS version 21. Preliminary analyses revealed that women's PNC utilization significantly varied across counties (data not shown), thus hierarchical logistic modeling was used to assess the association between county-level indicators of social and economic deprivation and women's individual utilization of PNC. To test the cross-level interaction between individual-level race and county-level measures of social and economic deprivation, we used random slope hierarchical logistic modeling. All hierarchical logistic modeling were conducted in HLM version 7. The proportion of variance explained was calculated in Microsoft Excel 2010.

Results

Descriptive and Bivariate Results. A total of 17% of women identified as African American and 83.3% as White. The mean age was 29.1 years and most women used private (64.6%) insurance during PNC. Relatively few women reported cigarette use (3.8%), having diabetes (3.4%) and/or hypertension (3.5%) during pregnancy. Approximately 36% of women received less than adequate PNC. Compared to White women, African American women were more likely to be younger (M = 26.31), use public insurance during PNC (20.3%), receive less than adequate PNC (36%), and experience hypertension (4.4%) (see Table 14).

Descriptive statistics for county-level variables are shown in Table 15. Approximately 17% of persons within each county lived below the federal poverty line. This is higher than poverty rates in the U.S. (13.5% living in poverty) and California (15% living in poverty) as a whole. On average, for about every seven African Americans across counties, there were 100 Whites who had a professional job. Similarly, on average, for about every six African Americans across counties, there were 100 Whites who had a management job and/or a bachelor's degree or higher. County-level ratios in professional job status were significantly associated with African American and White women's PNC utilization. County-level poverty, as well as ratios in management job status and educational attainment, were not significantly associated with African American and White women's PNC utilization.

Multivariate Results: Individual Characteristics. Table 16 shows the results of multilevel logistic regression with random slopes, presenting adjusted odds ratios for the

association between individual characteristics, county-level poverty, and indicators of social and economic deprivation with women's PNC utilization. In Model 1, racial status was significantly associated with PNC utilization; African American women were 1.41 times more likely to have received less than adequate PNC compared to White women. Insurance status (i.e., public and self-pay) and cigarette use significantly increased women's likelihood of having received less than adequate PNC, while younger age and complications during pregnancy (i.e., diabetes and hypertension) decreased women's likelihood of having received less than adequate PNC.

Multivariate Results: Individual Characteristics and County-Level Indicators of Social and Economic Deprivation. The addition of county-level poverty in Model 2 showed that there was not a significant association between county-level poverty and PNC utilization. However, the significant associations of race and other individual characteristics/behaviors with PNC utilization remained.

Models 3-5 added county-level indicators of social deprivation separately. The county-level African American to White ratio in professional job status was the only indicator of social deprivation significantly associated with PNC utilization, accounting for indicators of individual- and county-level poverty. Therefore, this improved the model fit and accounted for individual-level characteristics and county-level poverty compared to Model 2. Surprisingly, increasing the number of African Americans by one for every 100 Whites in professional jobs at the county-level increased a women's odds of having received less than adequate PNC by 3% (AOR 1.03, $p = 0.017$). County-level poverty remained non-significant. After accounting for indicators of social and economic

deprivation, individual racial status remained associated with receiving less than adequate PNC utilization. There was not a significant interaction between racial status and county-level professional job status (data not provided).

Table 14. Individual Characteristics, African American and White Primiparous Women, California Birth Statistical Master Files 2009-2013 (N = 531,170) (Paper 2)

Individual Characteristics	**White (n = 442355)**	**African American (n=88815)**	**Total (N = 531,170)**
	mean (SD)	mean (SD)	mean (SD)
Age**	29.6 (5.653)	26. 31 (6.205)	29.05 (5.879)
	% (n)	% (n)	% (n)
Insurance**			
Private	70.6 (312204)	34.5 (30671)	64.6 (342875)
Public	11.0 (48621)	20.3 (17997)	32.8 (174364)
Self-Pay	3.5 (15515)	4.0 (3523)	3.6 (19038)
Cigarette use during pregnancy*			
No	96.2 (425608)	96.4 (85595)	96.2 (511203)
Yes	3.8 (16747)	3.6 (3220)	3.8 (19967)
Complications during pregnancy			
Diabetes**	3.4 (15219)	3.1 (2746)	3.4 (17965)
Hypertension**	3.3 (14624)	4.4 (3908)	3.5 (18532)
Prenatal Care Utilization**			
Adequate	73.8 (326439)	64.0 (56817)	72.2 (147914)
Less than Adequate	26.2 (115916)	36.0 (31998)	27.8 (531170)

Note: Racial differences in means (i.e., age) were assessed using ANOVA. Race differences for categorical variables (i.e., insurance, cigarette use, pregnancy complications, and PNC) were assessed using Chi-square analysis. ** = p-value < 0.01, * = p-value < 0.05.

Table 15. County Characteristics for Counties in the Analytic Sample, US Census American Community Survey 2009-2013 (N = 33) (Paper 2)

Indicators of Social and Economic Deprivation	Mean (SD)	Range
Poverty	0.17 (0.06)	0.08-0.27
Professional Job Status Ratio [African American: White]*	7.02 (6.49)	0.54-26.81
Management Job Status Ratio[African American: White]	5.61 (5.04)	0.65-18.77
Educational Attainment Ratio[African American: White]	5.82 (5.29)	0.81-21.55

Note: Bivariate analyses were assessed using random slope hierarchical logistic modeling. SD = standard deviation. ** = p-value < 0.01, * = p-value < 0.05.

Discussion

Findings from this study highlight the complexity of African American women's lives and support the need for multilevel interventions aimed at increasing accessibility to and utility of preconception and prenatal care among this population (Wise, 2008). The percentage of women who received less than adequate PNC was strikingly high among the study sample compared to women in the U.S. and California as a whole (MOD, 2016), indicating that women in our sample are at higher risk for adverse birth outcomes. Supported by previous research (D'Angelo et al., 2016; Frisbie et al., 2001; Johnson et al., 2007; Partridge et al., 2012; Roberts & Nuru-Jeter, 2010; Xaverius et al., 2016; York et al., 1999), African American women in our sample, compared to White women, were more likely to be younger, have public insurance, and be diagnosed with hypertension, all factors associated with inadequate or no PNC.

To our knowledge, this was the first study to assess the association of social and economic deprivation measured by county-level African American to White ratios in job status and educational attainment on women's PNC utilization. The association between county-level African American to White ratios in professional jobs and women's PNC utilization was in the opposite direction than hypothesized. We found that as the ratio between African Americans and Whites in professional jobs reached equality at the county-level, both African American and White women in the sample were significantly more likely to have received less than adequate PNC when controlling for individual characteristics and county-level poverty. Given that county-level poverty was not a significant predictor of women's PNC utilization, adjusting for county-level poverty

could have masked the true magnitude inequities in employment status have on women's PNC utilization. Previous research supports community-level indicators of social and economic deprivation (measured by community deprivation indices and African American to White ratios in employment status) negatively impact birth outcomes (Mason et al., 2009; Messer et al., 2010; Wallace et al., 2015) and PNC utilization (Perloff & Jaffee, 1999) among African American and White women. However, these findings differ from current research on social and economic deprivation and PNC utilization, where only White women who live in highly deprived communities were more likely to initiate late or no PNC (Cubbin et al., 2008).

Findings from our study suggest that racism may undermine the protective aspects of social and economic equity in reducing racial disparities in PNC utilization (Mason et al., 2009). Research supports the idea that racism is a mechanism that segregates and differentiates access to resources, and impacts exposure to stressors among racial groups, resulting in negative social and economic consequences for African American communities (Dominguez, 2010; Kain, 1968; Massey, Condran, & Denton, 1987; Massey & Eggers, 1990; Schulz, Williams, Israel, & Lempert, 2002; Williams & Collins, 2001). Studies have found that in predominately Black communities, African American and White women are more likely to have adverse birth outcomes regardless of access to community resources (as measured by the neighborhood deprivation index) (Mason et al., 2009; Messer et al., 2010), suggesting that stressors related to racism may outweigh the benefits of increased access to resources.

Historically, women have received unfair treatment in the workplace as the result of "old-fashioned" sexism deeming women as inferior to men and unfit for the workplace (Benokraitis & Feagin, 1995), which is more covert and subtle in the modern workplace. To date, discrimination still occurs in the workplace, particularly in professional job settings. The level of discrimination is heightened among women who are pregnant and/or mothers (Hebl, King, Glick, Singletary, & Kazama, 2007; Heilman & Okimoto, 2008; Morgan, Walker, Hebl, & King, 2013). Therefore, women living in a county that is advancing racial equity standards in employment status may not derive any direct benefits on women's individual PNC utilization.

Limitations

This study used cross-sectional data and thus can neither assess life-course exposure to social and economic deprivation (as time in living in a women's residing county was unknown) nor make causal inferences. Nonetheless, findings from this study provide a snapshot of the association between exposures to social and economic deprivation with PNC utilization and can be replicated with longitudinal datasets. Finally, there are controversies in the literature over the conceptualization of PNC utilization. This study used the APCU Index because it includes the category "adequate plus," which measures women's experiences with intensive care and high-risk pregnancies and accounts for the percentage of PNC women received while adjusting for gestational age (Bloch et al., 2009; Kotelchuck, 1994).

Implications for Policy

Our study highlights the importance of understanding the role individual and contextual factors play in women's PNC utilization. Despite increased access to health care insurance through the Affordable Care Act (ACA) (Kaiser Foundation, 2016), findings from our study support the fact that African American women remain more likely to receive less than adequate PNC compared to White women residing in California. California was one of many states implementing state- and county-level initiatives to support Medi-Cal (California Medicaid) expansion and the open market. Since 2009, there has been a steady increase among California residents enrolled in public insurance coverage, with the biggest jump occurring from 2013 (8.6 million people) to 2014 (11.2 million people) (California HealthCare Foundation, 2017). Additional barriers African American women may face in receiving adequate PNC include lack of transportation, comfort with providers, and financial burdens (D'Angelo et al., 2016; Frisbie et al., 2001; Partridge et al., 2012; Phillippi, 2009). Therefore, expanding non-emergency transportation criteria for Medicaid patients to include women seeking preconception and prenatal care may assist with reducing racial inequities in PNC utilization.

Only one novel indicator of social and economic deprivation (i.e., African American and White ratios in professional jobs) was positively associated with receiving less than adequate PNC for both African American and White women. Our findings suggest that systemic racism and sexism, or an intersection of the two, may be at play, thus undermining the benefits of racial equity in job status on women's PNC utilization.

Future research should tease out the overlapping forms of oppression our measures of job status could not highlight, such as focusing on equity in employment status among African American and White women only. Furthermore, our findings may support the need for revising employment equity policies supporting women, and people of color in all organizations, regardless of position type and prestige (Hideg & Ferris, 2016).

Conclusion

Although PNC has mixed effects on reducing inequities in birth outcomes, it serves as a proxy for access to health care and may have immediate and long-term consequences on the health of women, infants, and children. Our results highlight the complexity of women's lives, particularly African American, supporting individual and contextual factors that are important to understand racial disparities in PNC utilization. Future research should explore more comprehensive ways to measure social and economic deprivation, which account for the unique nuances of being an African American woman.

Table 16. Adjusted Odds Ratios for the Association between Individual- Level Characteristics and County-Level Indicators Social and Economic Deprivation with Women's Less than Adequate Prenatal Care Utilization (N = 531,170) (Paper 2)

	Model 1	Model 2	Model 3	Model 4	Model 5
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Individual Characteristics					
Race					
White (reference)					
African American	1.41(1.27,1.56)**	1.41(1.27,1.56)**	1.41(1.27,1.55)**	1.41(1.27,1.55)**	1.41(1.27,1.56)**
Age	-0.97(0.96,0.98)**	-0.97(0.96,0.98)**	-0.97(0.96,0.98)**	-0.97(0.96,0.98)**	-0.97(0.96,0.98)**
Insurance					
Public (Private as reference)	1.54(1.26,1.87)**	1.54(1.26,1.87)**	1.54(1.26,1.87)**	1.54(1.26,1.87)**	1.54(1.26,1.87)**
Self-Pay	1.73(1.37,2.18)**	1.73(1.37,2.18)**	1.73(1.37,2.18)**	1.73(1.37,2.18)**	1.73(1.37,2.18)**
Cigarette Use (No as reference)					
Yes	1.90(1.71,2.12)**	1.90(1.71,2.12)**	1.90(1.71,2.12)**	1.90(1.71,2.12)**	1.90(1.71,2.12)**
Complications during Pregnancy					
Diabetes (No as reference)					
Yes	-0.62(0.58,0.66)**	-0.62 (0.58,0.66)**	-0.62(0.58,0.66)**	-0.62(0.58,0.66)**	-0.62(0.58,0.66)**
Hypertension (No as reference)					
Yes	-0.66(0.62,0.71)**	-0.66 (0.62,0.71)**	-0.66(0.62,0.71)**	-0.66(0.62,0.71)**	-0.66(0.62,0.71)**
Social and Economic Deprivation					
Poverty		-0.33 (0.00,25.68)	-0.21(0.00,12.52)	-0.30(0.00,22.20)	-0.28(0.00,20.93)
Professional Job Ratio			1.03(1.01,1.05)*		
Management Job Ratio				1.02(0.99,1.04)	
Educational Attainment Ratio					1.02(0.99,1.04)
Random Variance					
Intercept (SD)	0.31(0.56)**	0.31 (0.56)**	0.28(0.53)**	0.31(0.55)**	0.30(0.55)**
African American, Slope (SD)	0.08(0.29)**	0.09(0.29)**	0.09(0.29)**	0.09(0.29)**	0.09(0.29)**
Goodness of Fit Statistics					
Chi-square Statistics	18365.33	17309.15	18361.24	17523.21	17392.55
Degrees of Freedom	32	31	30	30	30

Note: OR = Odds ratio, CI = confidence interval, ** = p-value < 0.01, * = p-value < 0.05.

CHAPTER VI

DISCUSSION

Summary of Study Findings

Guided by the ecosocial theory (Krieger, 2012), this study examined the association between county-level indicators of structural racism and social and economic deprivation with African American and White women's prenatal care utilization and adverse birth outcomes for women residing in California. The two papers included in this dissertation focused on: (1) the association between traditional and novel county-level indicators of structural racism with women's birth weight and gestational age, and (2) the relationship between social and economic deprivation in regards to women's prenatal care utilization.

Findings from these papers highlight the importance of county-level indicators in understanding factors associated with maternal and infant health issues among African American and White women. County-level traditional (i.e., dissimilarity and isolation indices) and novel (i.e., African American to White ratios in board of supervisor positions and incarcerated felons) indicators of structural racism and social and economic deprivation (i.e., African American to White ratio in professional jobs) were significantly associated with prenatal care utilization and adverse birth outcomes among African American and White women residing in California. Supported by previous research,

only traditional indicators of structural racism (i.e., isolation index) significantly explained more variation racial inequities in adverse birth outcomes than individual-level factors and community poverty (Bell et al., 2006; Britton & Shin, 2013; Grady, 2006, 2010; Grady & Ramírez, 2008; Kramer et al., 2010; Mason et al., 2009; Messer et al., 2006). Results showed African American women are still at increased risk for receiving less than adequate PNC and having adverse birth outcomes, warranting the development of more comprehensive indicators of structural racism and social and economic deprivation.

Strengths and Limitations

First, this study used the most comprehensive population data available from the California Birth Statistical Master Files. These data allowed the selection of a specific study sample to examine inequities in birth outcomes. Due to the structure of the California Birth Statistical Master Files, the data could be combined with other publically available data sources (e.g., U.S. Census Bureau American Community Survey) to conduct multilevel analyses to assess individual- and community-level factors affecting these inequities. Although this study used cross-sectional data and as a result cannot assess life-course exposure to racism or social and economic deprivation or establish causality, findings from this can be used to inform longitudinal studies assessing the cumulative effect of exposures to structural racism and social and economic deprivation across the life-course.

Second, in comparison to the U.S. and California as a whole (MOD, 2016), women in this study reported fewer preterm births and infants born at low-birth weight

and were more likely to receive less than adequate prenatal care. Lower percentages of adverse birth outcomes found among women in this study were expected due the study's exclusion criteria procedures (e.g., previous birth, multiples) as these exclusionary factors are associated with adverse birth outcomes (Bell et al., 2006). Therefore, findings from this study assessed the association of county-level indicators on maternal and infant health outcomes among women who are at lowest risk for having adverse birth outcomes.

Third, this was the first study to use counties as the geographic scale to assess racial segregation and social and economic mobility on women's individual maternal and infant health outcomes. Counties are unique geographic scales and have the opportunity to elect governing bodies and distribute resources, both key components related to the development and perpetuation of racism (Bambhroliya et al., 2012; Gutnik & Castro, 2016; Hipp, 2015; Jia et al., 2009; Sommers et al., 2015). There is only one study that measured residential segregation at the county-level assessing its impact on county-level adverse birth outcomes (Nyarko & Wehby, 2012), lacking empirical evidence on the association between county-level structural racism and adverse birth outcomes experienced by individual women (Nyarko & Wehby, 2012).

Fourth, this was also the first study to use more comprehensive measures of structural racism and social and economic deprivation, specifically measuring the ratio of African Americans to Whites in job status and employment, educational attainment, and judicial treatment at the county-level on African American to White women's prenatal care utilization and adverse birth outcomes. Due to this study changing the geographic scale from states to counties within California, all novel indicators of structural racism

proposed by Lukachko et al. (2014) were unable to be measured (see Table 4). Findings from this study support the hypothesis that county functioning can negatively impact African American and White women's maternal and infant health.

Although there are a plethora of studies analyzing traditional measures of structural racism on adverse birth outcomes (e.g., Grady, 2010; Kramer et al., 2010; Messer et al., 2010), this study contributes to the literature by utilizing county-level traditional and novel indicators of structural racism and social and economic deprivation on women's prenatal care utilization and adverse birth outcomes. Findings from this study support the importance of county-level traditional indicators of structural racism (i.e., isolation) in understanding racial inequities in adverse birth outcomes. This study found that county-level novel indicators of structural racism (i.e., political participation and incarceration) were significantly associated with lower infant birth weight, and novel indicators of social and economic deprivation (i.e., job status) with less than adequate prenatal care for both African American and White infant birth weight. These findings suggest that racism and sexism, or the intersection of the two, may undermine the protective aspects of racial equity in political participation and job-status, and that county-level racial segregation and inequities are detrimental to both African American and White women's maternal and infant health issues (Mason et al., 2009; Perloff & Jaffee, 1999; M. Wallace et al., 2013).

Implications for Future Research

This study highlights the complexity of women's lives, particularly African American women, supporting the importance of examining both individual- and county-

level factors to better understand maternal and infant health issues. While novel indicators of structural racism and social and economic deprivation were associated with adverse maternal and infant health outcomes for both African American and White women, they add weight to the importance of developing more complex measures of structural racism and social and economic deprivation to understand racial inequities. Future studies should explore how these novel approaches operate on at the metropolitan statistical areas, census tracts, and zip code levels due to research suggesting racism may function differently by geographic scale (Bird, 1995; Massey et al., 2009). Additionally, future research should explore the collective impact poverty and indicators of structural racism may have on adverse birth outcomes among Black and White women.

Findings from this study also suggest there is a lack of policy to address overlapping forms of oppression African American women may encounter, such as structural racism and sexism. Racism and sexism, or the intersection of the two, may mask the protective factors equity in job-status and political participation may have in reducing racial disparities in adverse birth outcomes and prenatal care utilization. Historically, women have received unfair treatment in the workplace as the result of sexism that views women as inferior to men and unfit for the workplace (Benokraitis & Feagin, 1995). To date, discrimination still occurs in the workplace, particularly in professional job settings (Hideg & Ferris, 2016). Furthermore, our findings support the need for revising employment equity policies supporting women, and people of color in all organizations, regardless of position type and prestige (Hideg & Ferris, 2016).

Findings from this study also support the overrepresentation of African Americans in the jail and prison systems is detrimental to both African American and White infants' health. According to the JFA Institute (2007), there are negative individual (e.g., mental health issues), interpersonal (e.g., single status), and structural (e.g., disenfranchised and reducing job status and earnings) consequences associated with incarceration. There is an imperative need to explore ways to reduce racial disparities in over-incarceration of African Americans as a mode to improve both African American and White women's infant health.

Conclusion

This study was the first to assess the association of indicators of structural racism, both traditional and novel, and social and economic deprivation with women's prenatal care utilization and adverse birth outcomes. Indicators of structural racism and social and economic deprivation were negatively associated with both African American and White women's prenatal care utilization and adverse birth outcomes. Findings from this study confirm the utility of traditional indicators of structural racism in understanding some contributors to racial inequities in adverse birth outcomes between African American and White women. Although novel indicators of structural racism and social and economic deprivation was associated with adverse birth outcomes for African American and White women, novel indicators did not help explain any additional variation in racial inequities. Future studies should explore more comprehensive methods to measure indicators of structural racism and social and economic deprivation. Findings from this study have implications for policy regarding access to health care insurance and equitable working

environments to increase optimal maternal and infant health outcomes for both African American and White women.

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APPENDIX A

PERMISSION TO USE DATA LETTER

FRESNO STATE
College of Health and Human Services

September 16, 2016

To: Cristy McGoff, MA, Director, Office of Research Integrity
University of North Carolina, Greensboro

From: John A. Capitman, PhD, Principle Investigator

Subject: Permission to use data

The Central Valley Health Policy Institute at Fresno State University grants Brittany Chambers permission to use the California Master Birth Files, 2009-2013, for her dissertation research.

Sincerely,

Dr. John A. Capitman, Ph.D.
Executive Director, Central Valley Health Policy Institute
Professor of Public Health

APPENDIX B

DESCRIPTION OF DATA

Available Birth and Fetal Death Variables

The table below lists variables found on two different types of birth data files: Birth Cohort and Birth Statistical Master. Also displayed in the table below are the variables found on the Fetal Death Statistical Master File. Not all variables listed are available for all years, particularly older years. The coding of variables may also change over time. For more information about specific variables, please contact the Health Information and Research Section.

Variable	Birth Cohort	Birth Statistical Master	Fetal Death Statistical Master
Abnormal Conditions	X	X	X
Age of Decedent	X		
Age of Father	X	X	X
Age of Mother	X	X	X
Amendment Type	X		
Autopsy Performed on Decedent	X		X
Biopsy Performed on Decedent	X		
Birth Local Registrar's Number (1)	X	X	
Birth Local Registration District	X	X	
Birth Order	X	X	X
Birth State File Number (1)	X	X	
Birthplace of Mother	X	X	X

Birthweight (In Grams)	X	X	X
Census Place Mother's Residence	X	X	X
Census Tract of Mother's Residence (2)		X	
Complication of Labor/Delivery	X	X	X
Complication of Pregnancy	X	X	X
County of Birth/Delivery	X	X	X
Date of Birth/Delivery	X	X	X
Date of Birth Registration	X	X	
Date of Child's Death	X	X	
Date of Decedent's Death	X		X
Date of Fetal Death Registration			X
Date of Last Live Birth	X	X	X
Date of Last Menses	X	X	X
Date of Last Termination	X	X	X
Death in Hospital	X		
Death Local Registrar's Number (1)	X		
Death Local Registration District	X		
Death Reported To Coroner	X		X
Death State File Number (1)	X		
Expected Principal Source of Payment for Delivery	X	X	X
Father's Date of Birth	X	X	
Father's Multi-Race Code (3)		X	
Father's Years of Education	X	X	X
Fetal Death State File Number			X
Fetal Death Local Registrar's Number (1)			X
Fetal Death Local Registration District			X
First Name of Child (1)	X	X	X
Group Cause of Death (4)	X		

Hispanic Origin Code of Father	X	X	X
Hispanic Origin Code of Mother	X	X	X
Hispanic Origin of Decedent	X		
Hospital Ownership Code			X
Hour of Birth/Delivery	X	X	X
Infant Group Cause of Death (4)	X		
Last Name of Child (1)	X	X	X
Last Name of Father (1)	X	X	X
Length of Gestation (In Days)	X	X	X
Live Births Now Deceased	X	X	X
Live Births Now Living	X	X	X
Maternity Hospital Code	X	X	X
Method of Delivery This Birth	X	X	X
Middle Name of Child (1)	X	X	X
Month Prenatal Care Began	X	X	
Mother's Date of Birth	X	X	X
Mother's First Name (1)	X	X	X
Mother’s Maiden Name (Birth Surname) (1)	X	X	X
Mother's Multi-Race Code (3)		X	
Mother's Place of Residence	X	X	X
Mother’s Residential Address (1)		X	
Mother's Residential Zip Code	X	X	X
Mother's Years of Education	X	X	X
Multiple Conditions of Death			X
Number of Prenatal Care Visits	X	X	
Operation Performed	X		
Place of Decedent’s Residence	X		
Place Where Death Occurred	X		
Planned Birthplace	X	X	
Principal Source of Payment for Prenatal Care	X	X	X
Race-Ethnicity of Decedent	X		
Race-Ethnicity of Father	X	X	X
Race-Ethnicity of Mother	X	X	X
Sex of Child	X	X	X

State of Residence of Mother	X	X	
Terminations 20 Weeks Plus	X	X	X
Terminations Before 20 Weeks	X	X	X
Total Children Born Alive	X	X	X
Total Children Ever Born	X	X	X
Type of Birth	X	X	X
Type of Certifier of Birth	X	X	
Type of Certifier of Death	X		X
Type of Event	X	X	
Type of Facility Where Decedent Died	X		X
Underlying Cause of Death (4)	X		X
Year of Event	X	X	

Footnotes

1. These variables are personal identifiers and are considered confidential. Researchers must obtain CPHS and VSAC approvals in order to access these variables.
2. Census Tract is not consistently collected. Some Local Registration Districts code it, while others do not.
3. Multiple race fields are available on the birth data files as of 2000.
4. International Classification of Disease (ICD) codes have changed over time. Data files from 1999 onward are coded with ICD-10th Revision. Files from 1989 through 1998 are coded using ICD-9th Revision.

APPENDIX C

IRB EXEMPTION

IRB ori@uncg.edu
Wed, Sep 28, 2016 at 11:09 AM
To: BDCHAMBE@uncg.edu
Cc: irbcorre@uncg.edu, AETANNER@uncg.edu
To: Brittany Chambers
Public Health Education
From: UNCG IRB
Date: 9/28/2016
RE: Notice of IRB Exemption

Exemption Category: 4.Existing data, public or deidentified
Study #: 16-0331

Study Title: Indicators of structural racism and adverse birth outcomes among African American and White women: testing the role of two mediated pathways

This submission has been reviewed by the IRB and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b).

Study Description: The purpose of this study will be to assess the association of structural racism and adverse birth outcomes, and the mediated role inadequate medical care and economic and social deprivation play in this relationship among African American and White women residing in California. The study will involve secondary data analysis using the California Statistical Master Birth Files 2009-2013.

Investigator's Responsibilities: Please be aware that any changes to your protocol must be reviewed by the IRB prior to being implemented. Please utilize the most recent and approved version of your consent form/information sheet when enrolling participants. The IRB will maintain records for this study for three years from the date of the original determination of exempt status. Signed letters, along with stamped copies of consent forms and other recruitment materials will be scanned to you in a separate email. Stamped consent forms must be used unless the IRB has given you approval to waive this requirement. Please notify the ORI office immediately if you have an issue with the stamped consents forms.

Please be aware that valid human subjects training and signed statements of confidentiality for all members of research team need to be kept on file with the lead investigator. Please note that you will also need to remain in compliance with the university "Access To and Retention of Research Data" Policy, which can be found at http://policy.uncg.edu/university-policies/research_data/.

APPENDIX D

CORRELATION TABLES

Table 17. P-values for Comparison Statistics among Individual-Level Predictor Variables

	Age	Insurance	Education	PNC Utilization	Cigarette use	Diabetes	Hypertension
Age	--	.000	.000	.000	.000	.000	.000
Insurance	.000	--	.000	.000	.000	.000	.000
Education	.000	.000	--	.000	.000	.000	.000
PNC Utilization	.000	.000	.000	--	.000	.000	.000
Cigarette use	.000	.000	.000	.000	--	.000	.000
Diabetes	.000	.000	.000	.000	.000	--	.000
Hypertension	.000	.000	.000	.000	.000	.000	--

Table. 18 Correlations between County-Level Predictor Variables

	Isolation	Dissimilarity	Concentration	Educational Attainment	Incarceration	Management Job	Professional Job	Board of Supervisors	Proportion Medicaid	Proportion African American	Poverty
Isolation	1	.851**	.068**	.732**	.813**	.847**	.767**	.568**	.145**	.789**	.229**
Dissimilarity	.851**	1	-.150**	.346**	.674**	.511**	.389**	.462**	-.056**	.426**	.048**
Concentration	.068**	-.150**	1	.293**	-.133**	.197**	.246**	-.186**	.450**	.085**	.487**
Educational Attainment	.732**	.346**	.293**	1	.582**	.949**	.983**	.378**	.263**	.863**	.270**
Incarceration	.813**	.674**	-.133**	.582**	1	.761**	.596**	.826**	-.039**	.724**	-.005**
Management Job	.847**	.511**	.197**	.949**	.761**	1	.952**	.509**	.220**	.924**	.257**
Professional Job	.767**	.389**	.246**	.983**	.596**	.952**	1	.368**	.268**	.896**	.278**
Board of Supervisors	.568**	.462**	-.186**	.378**	.826**	.509**	.368**	1	-.128**	.493**	-.147**
Proportion Medicaid	.145**	-.056**	.450**	.263**	-.039**	.220**	.268**	-.128**	1	.162**	.921**
Proportion African American	.789**	.426**	.085**	.863**	.724**	.924**	.896**	.493**	.162**	1	.184**
Poverty	.229**	.048**	.487**	.270**	-.005**	.257**	.278**	-.147**	.921**	.184**	1