ABSTRACT

Title of Document: NEIGHBORHOOD LEVEL DISADVANTAGE,RACE/ETHNICITY AND INFANT MORTALITY IN WASHINGTON DC

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This study examines the effects of neighborhood level disadvantage and individual level characteristics such as race/ethnicity on infant mortality. Social determinants of health theory and ecological theory were used to construct a neighborhood advantage index for Washington DC. Secondary analyses were conducted using linked birth/death certificate and census data from the DC State Center for Health Statistics. Live births (55,938) and infant deaths (607) occurring in Washington DC from 2001-2007 were examined. Multilevel modeling techniques were utilized to determine the relationship between individual and neighborhood level factors on infant mortality. The research questions were: (a) Do women who are comparable on factors such as maternal education and marital status experience different rates of infant mortality by race? (b) Do women living in areas of high disadvantage experience higher rates of infant mortality than women living in areas of low disadvantage? (c) Does the effect of race/ethnicity on infant mortality change if the mother lives in a place of high disadvantage versus low disadvantage? (d) Does having an infant born preterm or low

birth weight increase the risk of infant mortality? Whites have the lowest rates of infant mortality (2.8/1000), followed by Hispanics (7.4/1000), with Blacks having the highest rates (15.2/1000) after adjusting for age, education, and marital status. These findings are consistent with previous research affirming a relationship between race/ethnicity and infant mortality. Infants born in disadvantaged neighborhoods are 1.63 times more likely to die before their first birthday than those born in advantaged neighborhoods. The odds for infant mortality compared to Whites decreases especially for Blacks (5.39 to 3.10; 42% change), living in disadvantaged communities even when race/ethnicity was interacted with the neighborhood disadvantage index. This suggests that disadvantage has different consequences for different race/ethnicity populations living in those neighborhoods. The importance of place (disadvantaged or advantaged neighborhood) in relation to infant mortality at the neighborhood level in addition to improving individual level factors is discussed for program development and policymakers. Implications for health disparities, maternal and child health, social support and future public health research are presented.

NEIGHBORHOOD LEVEL DISADVANTAGE, RACE/ETHNICITY AND INFANT MORTALITY IN WASHINGTON DC.

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Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

A lack of improvement in the rates of infant and neonatal mortality over the past couple of decades has warranted additional research in this area (Lee, Nigel, Gartner, Pearlman, & Gruss, 1980; Brosco, 1999). The lack of improvement in the rates directly contrasted the gains in infant mortality that had been made in previous decades. Specifically, in the years from 1950 to 1965, the rates for neonatal mortality declined 12% (Lee et al., 1980). In the 10 years from 1965 to 1975 the rates declined by 35% (Lee et al., 1980). Except for a small transient increase in the 1960's both the very low birth weight and the low birth weight rates were unchanged for a period of at least 25 years (Lee et al., 1980). In 1984, the black infant mortality rate in the United States was 18.4 per 1,000 whereas the white infant mortality was 9.4 per 1,000 (Sappenfield, Buehler, Binkin, Hogue, Strauss, & Smith, 1987,). Additionally, the ratio of Black to White infant mortality was nearly the same in 1984 (1.96) as it was in 1960 (1.93) (Sappenfield et al., 1987; Brosco, 1999). Furthermore, the neonatal mortality rate dropped by 89%, reaching a low in 1999 of 4.7 (Alexander, Kogan, Bader, Carlo, Allen, & Mor, 2003).

Infant mortality is a tragic event for families and communities and is also an indicator of the health of a nation. Congenital malformation is the leading factor associated with infant death in the United States, and in 2005 accounted for 20% of all infant deaths (MacDorman & Matthews, 2009a, CDC, 2008). A close second was disorders related to short gestation (preterm birth) and low birth weight that is not elsewhere classified, at 17% followed by sudden infant death syndrome (SIDS) at

8%, newborn deaths affected by maternal complications of pregnancy at 6%, and cord complications at 4% (MacDorman & Matthews, 2009a, CDC, 2008). Collectively, these causes of death for infants account for 55% of all infant deaths in the U.S. (MacDorman & Matthews, 2009a). For some of the leading causes of deaths such as SIDS and congenital malformation, the rates have decreased by 13% and 5% respectively, but for low birth weight the rates have either stayed the same or increased over time (MacDorman & Matthews, 2009a ; CDC, 2008).

Moreover, infant mortality varies by demographics of the mother such as race. Disorders related to short gestation (< 37 weeks) are the leading cause of death for Black infants, whereas congenital malformations are the leading cause of death for White infants (MacDorman & Matthews, 2009a). Short gestation is closely associated with low birth weight (<2500 grams), and low birth weight is a factor associated with first-year mortality risk, as well as the primary reason for the underlying racial disparity in infant mortality rates.

The prevalence of low birth weight and preterm births and their relationship to infant mortality are extremely important health issues in the United States. This issue is particularly important in minorities such as Blacks. Infant mortality in the United States is sizeable; there are more than 28,000 deaths of children less than 1 year of age every year in the United States (MacDorman & Matthews, 2008). As stated in the Healthy People 2010 report on Maternal, Infant, and Child Health, "as of 1995, the U.S. infant mortality rates ranked 25th among industrialized nations."A 2008 report from the National Center for Health Statistics showed a ranking of 30th for the U.S. infant mortality rates (MacDorman & Matthews, 2008). In addition, the disparity in

infant mortality rates between Whites and racial and ethnic groups (especially Blacks, American Indians and Alaska Natives, Native Hawaiians, and Puerto Ricans) persists.

A recent vital statistics report stated that Non-Hispanic Black infants in 2005 had the highest infant mortality rate in the U.S.; 13.7 per 1,000 live births compared to 5.7 per 1,000 live births among non-Hispanic Whites (MacDorman & Matthews, 2008). The Healthy People 2010 target goal for the U.S. infant mortality rate is 4.5 infant deaths per 1,000 live births (Healthy People, 2009). In 2005, there was a more than threefold difference in infant mortality rates by race and ethnicity that ranged from 13.7 for Black women to a low of 4.42 for Cuban women (MacDorman & Matthews, 2009a). Cuban women were the only group to achieve the Healthy People 2010 target goal of less than 4.5 infant deaths as of 2005 (Healthy People, 2009).

With respect to low birth weight babies, in 2006, Black women had 14.0 low birth weight babies per 100 births, while non-Hispanic White women had 7.0 low birth weight babies per 100 births (Martin, Hamilton, Sutton, Ventura, Menacker, Kirmeyer & Matthews, 2009). Table 1 provides an overview of the national data on low birth weight as reported in a recent vital statistics report showing the trend for low birth weight over time. .

Table 1. National Data on Rates of Low Birth weight, 1990, 2006 and 2007

Source: National Vital Statistics Report, 2009

Black	**White**	**Hispanic**
1990- 13.1 %	1990-5.6%	1990-6.1%
2006-14.0%	2006-7.3%	2006-7.0%
2007-13.6%	2007-7.2%	2007-6.9%

With regard to the percentage of all preterm births, from 2000 to 2006 the percentage of preterm births increased from 11.6% to 12.7% (Martin et al., 2009). In 2005, 68.6% of all infant deaths occurred to infants who were born preterm (MacDorman & Matthews, 2008). As also seen with low birth weight, Black women disproportionately accounted for nearly half of all infant preterm birth deaths, (46%), compared with White women (32%) (MacDorman & Matthews, 2008). Finally, in an international comparison, 1 in 8 births in the United States is preterm, compared with 1 in 18 births in Ireland and Finland for example (MacDorman & Matthews, 2009b).

Washington DC, parallels the U.S. in terms of high rates of infant mortality (Johnson-Clarke, 2009). The focus of the current study is on infnat mortality in Washington DC. Therefore, in order to address this health challenge on a local level and gain a better understanding of the unique dynamics that comprise Washington DC, it is important to examine each of the 8 geographic wards individually within the District of Columbia. All of the information below regarding the status of the District's wards was derived from the District of Columbia, State Center for Health Statistics. Figure 1 provides the location of the geographic wards in Washington DC and Table 2a and 2b provide selected demographics of Ward data.

Figure 1. Geographic Location of Wards in Washington DC

Table 2a: Selected Demographic Statistics of Wards- 2000 Census Data

Ward	Percent of Blacks (2000)	Percent of Whites (2000)	Percent of Hispanics (2000)	Percent of Population Unemployed	Median Income	Percent of Families In Poverty
Ward 1	46%	25%	25%	5.1%	$36,902	19.7%
Ward 2	20%	61%	10%	5.9%	$44,742	11.6%
Ward 3	6.2%	80%	6.6%	7.0%	$71,875	2.7%
Ward 4	71%	15%	12.0%	6.8%	$46,408	7.9%
Ward 5	88%	7.4%	3.0%	6.0%	$34,433	14.3%
Ward 6	63%	30%	3.2%	6.0%	$41,554	19.1%
Ward 7	97.0%	1.2%	0.8%	7.4%	$30,533	21.6%
Ward 8	93.0%	5.1%	1.3%	11.6%	$25,017	33.1%

Table 2b: Selected Demographic Statistics of DC-2000 Census Data

Percent of Population Unemployed	6.8%
Median Income	$40,127
Percent of Families In Poverty	16.7

With respect to neighborhood level data on the rates of unemployment, data from the year 2000 census indicate that unemployment rates were generally higher east of the Anacostia River in Wards 7 and 8 at 7.4 % and 11.6.2% respectively (Office of Planning, D.C., 2009). Table 2 provides a snapshot of economic indicators for Washington DC overall (Office of Planning, D.C., 2009).

Data on the DC Hispanic population are derived from the DC State Data Center and provide an overview of the Latino population. The federal government defines Hispanic or Latino as a person of Mexican, Puerto Rican, Cuban, South or Central American or other Spanish culture or origin regardless of race, thus Hispanics may be of any race. In 2007, Hispanics or Latinos represented about 15.1% of the U.S. total population. In the 2000 Census, DC reported a total of 44,953 or 7.9 percent of its population as Hispanic. However, the number of Hispanics in DC increased by 9.0 percent from 2000 to 2007, reporting an increased number at 49,016 Hispanics. Hispanics in DC are concentrated to specific neighbhorhoods, and most of the Hispanics live in the Northwestern quadrant of the city. Additionally, the majority of Hispanics in DC are from El Salvador (37.2%) or Mexico (14.4%). The majority of Hispanics in DC live in family households (54.3%) and the rates of marriage in Hispanic couples is higher than for the overall District (32.4% compared to 22.2%). With regards to indicators of poverty, almost 43% of Hispanics in the District did not

have a high school diploma, and about 70.2 percent of Latinos in DC lived in renter occupied housing (Office of Planning, D.C., 2009).

The analysis conducted for this research project builds on previous research examining the factors associated with infant death.The analysis elucidates the effect of social determinants of health at a neighborhood level on infant mortality in Washington DC. The social determinants of health approach are factors that collectively determine a woman's "place" in society as well as her actual physical location (Jackson, 2007). Examples of variables that represent the social determinants of health model include: area of residence, education, income level, and access to economic resources (Arrivillaga, 2009). Health care costs and accessibility vary greatly in Washington DC based on location and place, and this difference is in part due to differences in a community's economic prosperity or debt, as well as differences in policies and legislation enacted in specific communities (Matteson, Burr & Marshall, 1998). In this study it is posited that through multilevel modeling and the nesting of factors such as a neighborhood level disadvantage index, as well as characteristics such as maternal education and marital status, a more detailed relationship will be demonstrated with regard to whether or not the woman experiences infant mortality. In the past, researchers have claimed that poverty is increasingly becoming concentrated in urban areas and that the United States is in an age of economic extremes, thus leading to further isolation of people in poverty (Matteson, et al., 1998). This study assesses the effect of disadvantage in relation to infant mortality at a neighborhood/ward level.

Purpose

The present study examines health disparities, maternal and child health and neighborhood level influences on infant mortality. Collins, Wambach, David, & Rankin (2009a), Raux (2001a), and O'Campo, Xue, Wang, & Caughy (1997) have previously conducted research on the influences of neighborhood and place on infant mortality using multilevel modeling. Washington DC demonstrates diversity in income, access to resources, and demographics of its residents. The use of multilevel modeling allows for a closer examination of the main variables of interest to infant mortality. Finally, the use of neighborhood disadvantage as a main community level variable of interest has not been studied previously in Washington DC with regards to infant mortality and other adverse birth outcomes.

Infant mortality is examined in relation to demographic characteristics of the mother such as maternal race, age, marital status and educational attainment. Using linked birth death data from the District of Columbia, State Center for Health Statistics from 2001-2007, the relationship between race/ethnicity, low birth weight, neighborhood level poverty (as measured at the Ward level), and infant mortality for women in Washington DC is studied.

With a focus on race and the social determinants of health such as the level of disadvantage in a woman's neighborhood, individual factors such as her marital status, a previous history of preterm births (<37 weeks) and low birth weight (<2500 grams), this research examines the differences in infant death in Washington DC. Infant mortality is analyzed for infants born to women of different races while controlling for maternal age, maternal education, prenatal care and marital status. By

using the linked birth-death data and census data to glean indicators of advantage, this research further examines the characteristics of mothers such as race/ethnicity and communities in which mothers live, and the level of disadvantage in the neighborhood, to understand the factors associated with infant mortality in DC. The major research question is: How is infant mortality affected by the neighborhood in which the mother resides in Washington DC with regard to disadvantage at the Ward level and the race/ethnicity of the mother? The goal of this study is to identify those specific factors that can be addressed in programmatic and policy initiatives, in order best to reduce infant mortality health disparities in the District of Columbia.

Chapter 2: Literature Review

Social Determinants of Health Theory

In a report titled "Race, Stress, and Social Support: Addressing the Crisis in Black Infant Mortality", Jackson (2007) states that existing models that examine infant mortality in Blacks have failed to elucidate the main reasons for the two-fold gap between Blacks and Whites. Jackson posits a new model should be developed that encompasses the social determinants of health theory, and that women and their babies must be viewed not only as individuals but as members of families, communities, and larger systems that have either positive or negative impacts on their psychological and physical state. Thus, the social determinants of health theory would be beneficial in the further exploration of the relationship of neighborhood level to adverse birth outcomes such as infant mortality. The financial benefits or constraints of their physical environment as well as protective and resiliency factors of their work, life, and recreational environment should be taken into consideration when planning programs with this population (Jackson, 2007).

The social determinants of health approach uses variables or factors that collectively determine a woman's "place" in society as well as her actual physical location (Jackson, 2007). Examples of variables that represent the social determinants of health model include: area of residence, education, and income level (Arrivillaga, 2009). The social determinant of health model is supported by substantial theory, practice, and epidemiological evidence. In particular, this approach addresses the growing evidence that social class is a major predictor of poor birth outcomes. Additionally, the social determinant of health model recognizes that there are social

influences on health which operate through a variety of mechanisms, one of which could be the neighborhood in which people live. The social determinant's of health model is the central theme of the present research and the basis of the research question as it relates to neighborhood influences on birth outcomes.

Ecological Theory and Adverse Birth Outcomes

The ecological system has implications for the family and public health research conducted in this study. Coined by Brofenbrenner, there are 5 layers in the ecological theory (Paquette & Ryan, 2001). These are:

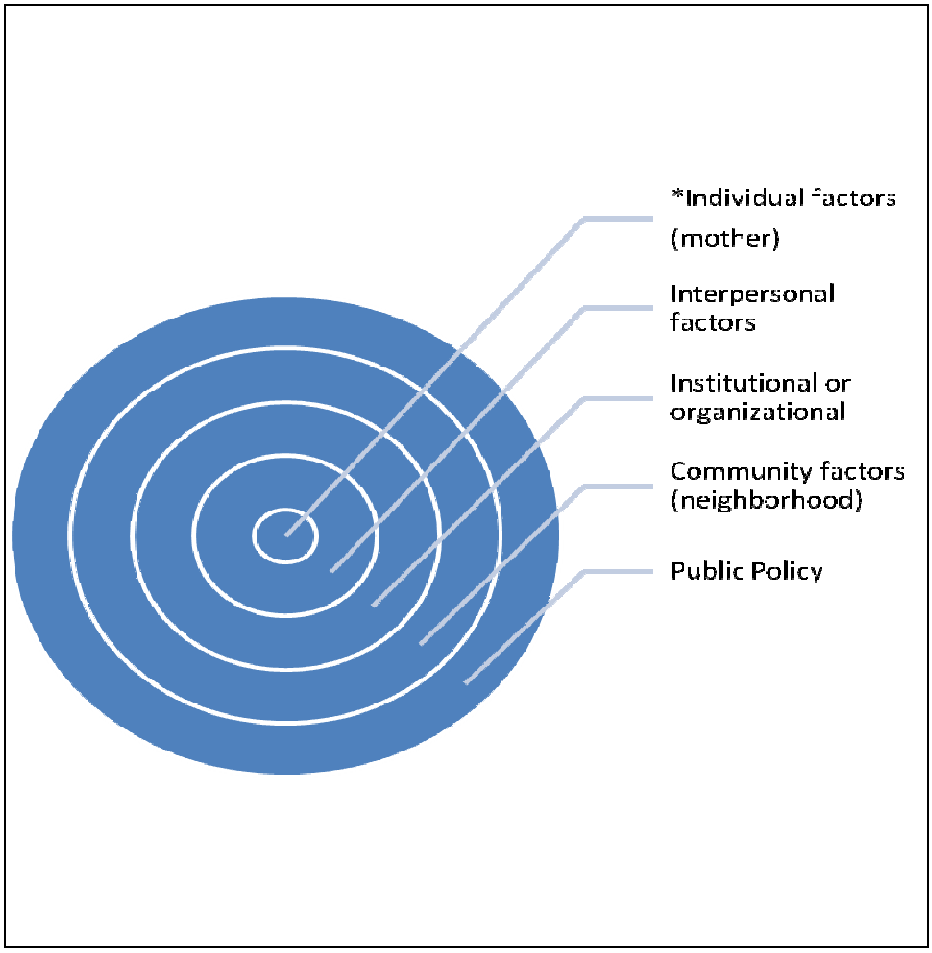
- The *microsystem* –Structures in the microsystem include family, school, and neighborhood. At this level, relationships have impact in two directions. Bronfenbrenner calls these *bi-directional influences,* and they occur among all levels of environment. The interaction of structures within a layer and interactions of structures between layers is key to this theory.
- The *mesosystem* – this layer provides the connection between the structures of the child's microsystem
- The *exosystem* – this layer defines the larger social system in which the child does not function directly.
- The *macrosystem* – this layer may be considered the outermost layer in the child's environment. While not being a specific framework, this layer is comprised of cultural values, customs, and laws (Berk, 2000). The effects of larger principles defined by the macrosystem have a cascading influence throughout the interactions of all other layers.

- The *chronosystem* – this system encompasses the dimension of time as it relates to a child's environments. Elements within this system can be either external, or internal.

From a public health perspective, the ecological theory states that a public health issue of concern such as infant mortality is the result of an overlap of many factors at different levels and their influence on infant mortality (Alio, Richman, Clayton, Jeffers, Wathington & Salihu, 2009). The ecological model posits two main concepts: 1) individual behavior affects and, in turn, is affected by the social environment and 2) behavior shapes and is shaped by many levels of influence (Alio et al., 2009). Alio et al. reference the five levels of the ecological model that can affect health behavior: 1) individual factors, 2) interpersonal factors, 3) institutional or organizational factors, 4) community factors, and 5) public policy factors. The ecological model, similar to the social determinants of health model, acknowledges that analyzing all of a person's environments such as the family, the community, and the social environment in which a person resides are integral to understand and alleviate health problems such as infant mortality (Alio et al.).

The ecological model provides a framework within which to examine and contextualize racial disparities in birth outcomes, demonstrating the multiple facets of interaction between parental and familial risk factors within the context of the community and society as a whole. Figure 2 illustrates the ecological model as it is commonly described in the literature. For this present study, only two levels of the ecological model, the individual, and the community factors are assessed both separately and collectively to examine the relationship to infant mortality.

Figure 2. Ecological Model



* The dependent variable of infant mortality, the independent variable of race/ethnicity, the community level variable of neighborhood disadvantage, the control variables of age, education, prenatal care, and marital status, the mediator variables of preterm birth, low birth weight, and prenatal care are all included at the individual level of the ecological model. Thus, the individual factors that affect infant mortality will be assessed, as well as the community level factors such as neighborhood. The current study posits that the various levels of the model, specifically the individual level and the community level interact and have a bi-directional influence on infant mortality outcomes for women in Washington DC.

Dependent Variable

Infant Mortality

The major dependent variable explored in this study is infant mortality. The rates of infant mortality have shown great improvement since the early 1900's. In 1915, the rate of infant deaths was 100 infants per 1,000 live births (Berger, 2001). In 2005 the rate of infant mortality for the United States as a whole was 6.86 (MacDorman & Matthews, 2008). This decline represents a 90% decrease in the rates of infant death for the United States, a feat that many medical and public health advances helped to achieve. Some of these advances include improvements in sanitation, pasteurization of milk, reduced fertility rates, and improved water and sewage (Berger, 2001).

According to Berger (2001), there were three specific periods of development the United States experienced that ultimately helped set the stage for a reduction of infant mortality rates. These periods were: 1930-1950, the development of antibiotics and fluid replacement techniques such as blood transfusions; the 1970's, the expansion of neonatal intensive care units to treat adverse birth outcomes; and the 1980's, artificial pulmonary surfactant treatment for respiratory distress that is common in many low birth weight babies. Additionally with regard to legislative action, the introduction of Medicaid services in the 1960's also improved birth outcomes by providing access to care for low-income women. Finally, public health played a major role in reducing infant mortality, by improving the rates of immunization in children, and reducing sudden infant death syndrome (SIDS) by placing infants on their backs to sleep. Over the past 40 years, the decline in infant

deaths experienced by White infants as compared to Black infants however has been faster, thus increasing the gap between the two groups.

Berger states that much of this racial difference in the neonatal period is attributed to low birth weight and preterm birth, and in the post neo-natal period the difference is a result of psychosocial factors experienced by Black women, such as racism, poverty, and being unmarried (Berger 2001; Brosco, 1999). The fact that not all groups have experienced the same rate of decline in infant mortality rates also suggests a disparity with regards to the social and medical advances that have improved the rates of infant mortality overall (Berger, 2001; Brosco, 1999). Additional factors that need to be considered with regards to disparities in infant birth outcomes are related to differences in maternal preconception health, maternal rates of infection, access to quality health care and stress (Berger, 2001; Brosco, 1999). Specifically, groups such as Black, American Indian and Puerto Rican women are more likely to have sociodemographic and behavioral risk factors, such as being a smoker, having lower education levels, starting prenatal care late, and having a fourth or higher birth order (MacDorman & Matthews, 2009a).

Independent Variables

Neighborhood Poverty

To begin a review of the independent variables included in the study, research on neighborhood poverty was examined, as the main independent variable of interest. The U.S. Census Bureau uses a set of dollar thresholds and family size to determine who is in poverty. If a family's total income is less than the threshold, then the entire family and the individual members of the family are considered to be in poverty. For

example, in 2007 the threshold was $21,834 for a family consisting of 2 adults and 2 children, (U.S. Census Bureau, 2007).

In a report from 2007, the District of Columbia has rates of poverty that are higher than the national average poverty rate (17.2% compared to 13.2%), and it is the 5th highest poverty rate in the United States, next to Mississippi, Arkansas, Kentucky, and Louisiana (Office of Planning, D.C., 2009). Additionally, the rates of poverty in DC vary by race and ward. In 2008, 23.6 percent of Blacks had incomes below the poverty level, compared with 8.1% of Whites, and 12.8% of Asians. For comparison, in 2008, 15.4 percent of all households in DC had incomes below the poverty level. Among family households, married-couple families were less likely to be in poverty than other families. Also, among other family households female households with no male present were more likely to be in poverty than male households with no female present (26.9% compared to 10.1%). Thus, poverty in general and neighborhood level poverty in particular for Washington DC are integral to the study of health disparities and inequities, such as infant mortality.

A California study examined the relationship between neighborhood characteristics and low birth weight by ethnicity and socioeconomic status (Pearl, Braveman & Abrams, 2001). The study included Asian, foreign-born Latina, U.S. born Latina, Black, and White women. The authors hypothesized that the magnitude of the association between neighborhood socioeconomic factors and birth weight would vary by ethnicity. The study included information on the rates of Medicaid coverage, income and education for the participants. The data were retrieved from 18 public and private hospitals in California, and subjects were randomly selected by

geographic region, proportion of deliveries to Black women, and the prevalence of private health insurance. Birth certificate data were obtained on all deliveries occurring at the hospitals during the interview phase of the study from August 1994 to July 1995. The researchers were able to geocode and link 94.3% (n = 23,922) of the cases to census tract and block group areas. Overall, they found that increasing neighborhood poverty and unemployment were associated with decreasing birth weight. When the results were stratified by ethnicity and birthplace, neighborhood socioeconomic characteristics such as the percentage of residents who were poor or unemployed were related to decreasing birth weight.

Of significant interest is that among Black women in the subsample with a full range of data, adjustment for income, education, age, timely prenatal care, fair or poor pre- pregnancy health, having a supportive person, living in an unsafe neighborhood, parity, and smoking did not affect the negative association between unemployment levels and birth weight (Pearl et al., 2001). Foreign-born Latinas living in neighborhoods with the highest rates of poverty and unemployment were associated with higher mean birth weight and lower risk of low birth weight .Interestingly, in all of the ethnic groups, neighborhood-level results were largely unaffected by inclusion of individual level socioeconomic measures, and vice versa. The authors concluded that most likely community and individual pathways link socioeconomic conditions to birth outcomes. Additionally, living in neighborhoods with high levels of unemployment or poverty, which are proxies for individual resources and assets, can result in lower birth weight infants for Black and Asian women.

Many Black women live in urban neighborhoods with very high rates of poverty that are clustered or concentrated in a certain geographic area. Additionally, these neighborhoods have high rates of violent crime which can directly or indirectly influence low birth weight (Collins, et al., 2009a). Neighborhood-level characteristics capture a dimension of socioeconomic conditions that may not be captured by individual-level measures, such as income or education (Pearl et al., 2001). Neighborhood poverty is also associated often with an increased rate of inadequate prenatal care utilization among urban Black and White women (Pearl et al.).

In a study on neighborhood poverty and low birth weight using data from Chicago, researchers found that 78% of Black women had a life-long residence in low-income neighborhoods, and that Blacks had a greater percentage of women who experienced downward financial mobility as compared to upward financial mobility as measured by place of residence at time of birth and at time of pregnancy (Collins et al., 2009a). Upward financial mobility is defined as growing up in a low-income neighborhood and moving to a high-income neighborhood, and downward mobility is defined as growing up in a high-income neighborhood and moving to a low-income neighborhood.

With regards to the birth outcomes experienced, Black women with a lifelong residence in low-income neighborhoods had an infant low birth weight rate of 17.1% compared to 11.7% for Black women with a lifelong residence in high-income neighborhoods. Also, Black women less than 20 years of age and with a low-income had a lower low birth weight rate than women ages 20-35 years of age (13.6% vs. 18.1%). The authors report that the population attributable rate of low birth weight for

maternal lifelong exposure to low-income as compared to lifelong exposure to high income was 23.6% for Blacks, showing a relationship to the almost one-fourth of low birth weights experienced by Blacks and the direct relationship to poverty. Finally, the authors conclude that increasing the prevalence of Black mothers with a lifetime residence in high-income neighborhoods could reduce the number of low birth weight infants in future generations. The results of the Collins et al. (2009a) study suggest that exposure to life in low income neighborhoods has a direct relationship to low birth weight for Blacks due to the constant stressors of poverty. Collins et al. (2009a) focuses on low birth weight, and sets the foundation for establishing a causal link for infant mortality as a precursor.

In another study conducted by researchers using data from Missouri's birth certificate database for 1989-1997, a multilevel logistic regression analysis was conducted to estimate the effects of county-level poverty on preterm birth risk (DeFranco, Lian, Muglia, & Schootman, 2008). The authors included individual level measures such as maternal age, maternal race, residence within city limits, birth sequence, indicators of low-income, and maternal health-related behaviors, such as smoking. Additionally, they included maternal education and socioeconomic status as dichotomous variables. They defined area level measures such as the poverty level into quartiles using the federal poverty line at the county level of the mother's reported residence as a measure of socioeconomic position. The study population consisted of 634,994 live births to mothers who resided in 115 counties in Missouri. Women who resided in counties with higher rates of poverty were significantly younger and more likely to be Black, less likely to graduate from high school, be

unmarried, and low income. The authors found a relationship between preterm birth and county-level poverty. Specifically, the rate of preterm birth increased with a higher county poverty rate. The risk increase resulted in women in counties with the highest poverty rate being 1.30 times more likely to deliver preterm. Additionally, the effect was similar when stratification was performed on the study population by race. Both Black and White mothers living in counties with the highest rates of poverty had an increased risk of preterm birth.

Collins et al. (2009a) examined neighborhood level poverty and found in their regression model that even after controlling for maternal age, education, prenatal care usage, and parity of women with a lifelong residence in high-income neighborhoods, the adjusted relative risk of infant low birth weight for Blacks compared to Whites was 1.9 (1.3-2.6). Thus, even when maternal factors are controlled for; the relative risk of low birth weight for Blacks is still twice as high as it is for Whites (Collins, David, Rankin, & Desireddi, 2009c). The work that Collins et al. (2009a) conducted provided a foundation for the current study and research questions. Neighborhood level poverty appears to be an important indicator in the relationship of variables such as race, maternal age, education, prenatal care usage, and parity of women to infant mortality. Intrinsically related to neighborhood level data and the study of infant mortality is the acknowledgement that health outcomes are related to a person's physical, social, and cultural environment, a measure of their disadvantage score.

In work done by Raux (2001a) on the relationship of area effects such as neighborhood on health, the author states that neighborhood differences are becoming

increasingly relevant in the context of poverty and geographic clustering of poverty along with other forms of disadvantage. Further, in a study on neighborhood disadvantage and birth outcomes, the author found that living in a neighborhood that was more affluent than expected (based on individual factors of the mother such as educational attainment) reduced the risk of low birth weight and preterm birth among Black women living in predominately Black neighborhoods (Pickett, Collins, Masi & Wilkinson, 2005). Additionally, the authors found that for Black women living in racially mixed neighborhoods there was no protective benefit for the reduction of low birth weight (Pickett et al.). The next section of the literature review examines important mediators of the relationship of infant mortality and contexutal factors such as poverty, birthweight, preterm birth and prenatal care. Thus although low birth weight is an important precursor to infant mortality, for the purposes of this study it serves as a mediator.

Mediators

Birth Outcomes: Low Birth Weight

In the United States, nearly two-thirds of low birth weight infants and nearly all very low birth weight infants are born preterm (Schempf, Branum, Lukacs, & Schoendforf, 2007). Low birth weight continues to be the strongest predictor of infant mortality, followed by preterm birth (Berger, 2001). In 2000, 65% of all infant deaths were related to being born low birth weight (Berger). Previous research has stated that infants who are born low birth weight are 40 times more likely to die in the first month of their life, and those that do survive are twice as likely to suffer more multiple complications (Berger). In 2000, a study reported that 49% of low birth

weight infants have a greater chance of growing up with neurological and developmental disabilities (Berger). This percentage represents almost half of the infants that are born low birth weight, and these statistics have great health, and social implications for the parents of the infant and society. More specifically, 5 to 9% of the low birth weight infants experience cerebral palsy, and 19% of low birth weight infants have cognitive disabilities (Berger). Additionally, low birth weight is the primary reason that underlies the racial disparity in infant mortality rates. Specifically, as the proportion of Blacks relative to the total population increases, Black individuals experience higher odds of low birth weight (Walton, 2009.) Blacks continue to have higher proportions for preterm and LBW births, compared with either whites or Hispanics. At the same time, blacks experience lower risks of neonatal mortality for preterm and LBW infants, while having higher risks of mortality among term, post term, normal birth weight, and macrosomic births (Alexander et al., 2003). Low birth weight may be caused by preterm delivery, intrauterine growth restriction, or a combination of the two (Berger). Research has established that risk factors for preterm birth are similar to those of low birth weight.

Birth Outcomes: Preterm Birth

Preterm birth is a leading cause of infant morbidity and is associated with many familial, social, and economic costs (Schempf et al., 2007). Infants born preterm are more likely to experience infant mortality than infants born to term (Schempf et al.). When an infant is born preterm, (defined as 36 weeks or earlier), if it survives, it is predisposed to many health conditions over the course of its life, such as a lower intelligence quotient and chronic health problems. Additionally, infants

who are born to term have a better chance of being born at a higher birth weight, which is a protective factor against infant mortality. Preterm delivery contributes greatly to the excess mortality rate among Black infants (Rowland-Hogue & Douglas, 2005). Whereas 20 years ago, black infants who were born preterm or of low birth weight were more likely to survive than White infants of the same gestational age or birth weight; in 2001 Black infants were less likely to survive than White infants, regardless of gestational age or birth weight category (Rowland-Hogue & Douglas). Specifically, 75% of all excess deaths of Black infants were those infants who weighed less than 1,500 grams, or who were born at less than 32 weeks (Rowland-Hogue & Douglas). In 2005, the percentage of infants born preterm (<37 weeks of gestation) was significantly higher for non-Hispanic Black (18.4%), Puerto Rican (14.3%) and American Indian women (14.1%) than non-Hispanic White women (11.7%) (MacDorman & Matthews, 2009a).

The preterm-related infant mortality rate for Black women in 2005 was higher than the total infant mortality rate for White, Mexican, Central and South American, and Asian-Pacific Islander women combined (MacDorman & Matthews, 2009a). In 2005, 0.8% of births occurred at less than 28 weeks gestation, but accounted for nearly half (46.4%) of infant deaths. In general, the risk of infant death is decreased as gestational age increases. Interestingly, infants born in the late preterm period (34-36 weeks of gestation) have higher rates of infant mortality as well, experiencing infant death at three times the rate for full-term infants (MacDorman & Matthews). Even infants born early during the medically accepted term period of (37-39) weeks of gestation still have mortality rates that are 30.0% higher than infants born at 40-41

weeks (MacDorman & Matthews). Additionally, infants born to mothers who were not married had increased rates of preterm birth, regardless of race/ethnicity (Masi, Hawkley, Piotrowski & Pickett, 2007). These data suggest that preterm birth is a complex maternal and child health issue and further research is warranted. The risk factors for preterm birth and low birth weight include lower socioeconomic status (as defined by occupation, income, or educational attainment), prenatal care, Black race, multiple pregnancies, extremes of ages, and illicit drug use (Masi et al.).

Controls

Maternal Age and the Weathering Hypothesis

In work by Geronimus (1996) it was found that due to worsening health profiles, Black women may experience a larger negative effect of advancing maternal age on infant health than White women. This deterioration in reproductive health status over the childbearing years among Black women has been coined as "weathering" (Jackson, 2007). The weathering hypothesis conceptualizes the cumulative impact of repeated exposure to social or economic adversity and political marginalization on female reproductive outcomes. Physiologically, persistent and high-intensity coping with acute and chronic stressors can have a profound effect on health (Geronimus, Hicken, Keene & Bound, 2006). Neighborhood poverty also drives the weathering hypothesis among urban Black women and contributes to the racial disparity in infant birth weight (Collins et al., 2009a). In a recent study, the authors found that the weathering pattern of maternal age and infant birth weight was specific to Black women with a lifelong residence in low-income urban neighborhoods. Interestingly, the infant low birth weight rates did not increase with

maternal age among Black women with a life-long residence in high income neighborhoods (Collins et al.). Finally, Black women in their early thirties with lifelong residence in high-income neighborhoods had an infant low birth weight rate half that of Black women in their early thirties with a lifelong residence in low-income neighborhoods (Collins et al.). The same is true for White women with a lifelong residence in high-income neighborhoods when compared to White women in low-income neighborhoods. Thus, the weathering hypothesis is useful in informing the selection of the variables for this study.

Maternal Education

In previous work by Kleinman and Kessel (1987) on risk factors for adverse birth outcomes, the authors found that Black women with low levels of education were 59% more likely to have babies with moderately low birth weights, but the level of education did not make a significant difference with regard to the birth of infants with very low birth weights (Kleinman & Kessel,1987; Singh & Kogan, 2007) conducted research on the relationship of maternal education to infant mortality in the United States between 1969 and 2001. The authors found that educational inequalities in total infant mortality were driven largely by educational gradients in mortality among normal birth weight infants. Additionally, Singh and Kogan (2007) posit that the effect of maternal education on infant mortality may reflect an increasingly important role of social and environmental influences on infant mortality risks in the United States. Finally, they noted that disparities in infant mortality by maternal education were also greater for whites than for Blacks, Hispanics, and Asian/Pacific Islanders (Singh & Kogan).

Marital Status

Research on marital status and its relationship to birth outcomes has shown that Black and White unmarried women had a substantially higher risk of having infants with very low or moderately low birth weights (Kleinman & Kessel, 1987; Young & Declerq, 2009). Specifically, among Whites there was a higher risk for very low birth weight than for moderately low birth weight (Kleinman & Kessel, 1987). With regards to Blacks, the excess risks were the same for both categories of birth weight. The authors conclude that marital status is more likely a surrogate or marker for a myriad of other factors that are more causally related to pregnancy outcomes and thus public health interventions (Kleinman & Kessel; Young & Declerq, 2009).

Prenatal Care

Mothers of low birth weight infants (as compared with non-low birth weight infants) were less likely to have attended college and to have adequately utilized prenatal care (Collins, et al., 2009a). Prenatal care is often used as a feasible, reliable route for locating and managing the medical, sociodemographic, and behavioral risk factors that may increase the risk of a woman having a poor pregnancy outcome (Taylor, Alexander, & Hepworth, 2005; Johnson, Khoratzy, Hatcher, Wingrove, Milligan, Harris, Richards, 2003). Amongst the public health and medical community there is a widespread belief and effort that women need to have prenatal care at the earliest point possible in their pregnancy. Unfortunately, for many women prenatal care is not received prior to delivery. In the United States, there are approximately 1.5 to 2% of women (70,000) who do not receive any care at all prior to delivery. A complete lack of prenatal care is a problem in the maternal and child health arena

because it deprives the medical provider from screening and treating the women for conditions that are manageable with care, especially among women with little or no prior medical care. There are many reasons that women do not access prenatal care during their pregnancy, such as a lack of availability in their area, financial barriers to care, cultural attitudes and beliefs about care, and not understanding the importance of receiving care.

A recent study analyzed the types of women that do not receive prenatal care at all, to determine if there were any characteristics among them that were similar, or whether or not the reasons that women were not receiving care were different and varied (Taylor, Alexander, & Hepworth, 2005). The authors also wanted to establish a risk profile for the type of women who do not access prenatal care, and compare the birth outcomes of these women, with women who received any kind of prenatal care. The authors used data from White, Black, and Hispanic women in the United States, using a linked birth-death file from the National Center for Health Statistics, 1995-1997 data. The total sample size was 126,220 records, and no care at all was defined as having a zero entered for the number of prenatal care visits, or having a zero or blank entry for the month care began.

Using a cluster analysis tool, the women were clustered based on: age, race, marital status, education, parity, nativity/birthplace, urban/suburban/rural residence, tobacco use, alcohol use, hypertension, and diabetes. The results of the study found six distinct no-care clusters: Cluster 1: Members of this cluster were more likely to be married (65%), White (69%) and reported the highest proportion of diabetes (Taylor et al.). Cluster 2: Almost half of this cluster was married, lived in suburbs, had low

medical and behavioral risks and was foreign-born Hispanic (89%). Cluster 3: Most of the group (91%) was foreign-born Hispanics, almost 50% were married, had completed elementary school, lived in the suburbs, and reported low medical and behavioral risk. Cluster 4: Members of this group were the least likely to be primaparous (14%), have extremely high behavioral risks (32% of the group smoked, and almost 10% drank alcohol), and were the least likely to be married (78%). Additionally, most members of Cluster 4 were young Black women with low education, and high risk factors. Cluster 5: Members of this cluster were less likely to be married, more likely to be White (46%) and they reported having more than a high school education (12.8 years on average). Finally, Cluster 6: Members of this cluster were young, (< than 20 years old), Hispanic (51%); not married, had low education (8.7 years on average), live in an urban dwelling, and had the 2nd highest rates of smoking (17.8%).

Overall, the birth outcomes for the no-care group were two to four times worse for every measure of birth outcomes (low birth weight, preterm birth, and gestational age) when compared to the entire population (Taylor et al., 2005). For example, the rate of low-birth weight in the total population was 6.07%, whereas in the total no-care group, it was 20.84% the highest rates of low birth weight, at 24.59% were seen in Cluster 4 (urban, young, Black, not married, low education, and high risk factors). The rates of infant mortality in the total no-care group were almost 5 times greater than the total population. Cluster 4 (urban, young, Black, low education and high risk factors) had the highest odds ratio for nearly every adverse birth outcome. Conversely, the best outcomes were for Cluster 6 (young, foreign-born

Hispanics with lower risk factor levels). With regards to Hispanic outcomes, the Hispanic paradox suggests that although some Hispanic women have low income and education, they have certain protective factors that moderate the normal relationship of low income and education on birth outcomes, such as better diets, higher rates of marriage, and strong family and cultural ties. Although the study has limitations usually seen with large data sets such as restricted maternal risk factors based on vital records, the results add to the body of literature on prenatal care, and identify women who should be targeted with regards to interventions and programs to improve their birth outcomes.

Research Questions and Hypotheses

This research is based on, and the results are expected to add to our understanding of the social determinants of health theory. The social determinants of health theory state that women are a part of many environments that shape their health and the adverse birth outcomes they experience, including infant mortality. Examples of these environments include their family environment (marital status, family income) and their economic environment (percent of poverty in ward). Additionally, as race/ethnicity is the central theme of this research, the relationship of maternal race/ethnicity to infant mortality with regard to the various environments (family, economic) of women is examined. The main area-level measure examined is the level of disadvantage in each ward.

The research questions that are tested and use the linked-birth death data are:

1. Do women experience different rates of infant mortality by race/ethnicity?

a. *Hypothesis 1a:* Rates of infant mortality will differ by race/ethnicity and by maternal factors such as maternal education, marital status, and maternal age.

b. *Hypothesis 1b:* Controlling for maternal education, maternal age, and marital status, women will experience different rates of infant mortality by race.

2. Do women living in areas of high disadvantage experience higher rates of infant mortality than women living in areas of low disadvantage?

    a. *Hypothesis 2a:* A woman in a place of high disadvantage as compared to a place of low disadvantage will have an increased risk of infant mortality.

    b. *Hypothesis 2b:* A woman in a place of high disadvantage will have an increased risk of infant mortality after controlling for marital status, maternal education, and maternal age.

3. Does the effect of race/ethnicity on infant mortality differ if the mother lives in a place of high disadvantage versus low disadvantage?

    a. *Hypothesis 3a:* The effect of race/ethnicity will differ with regard to infant mortality if the mother lives in an area of high disadvantage as compared to an area with lower rates of disadvantage.

    b. *Hypothesis 3b:* Controlling for maternal education, marital status, and maternal age, the effect of race/ethnicity will differ in areas of high disadvantage versus low disadvantage.

4. Will having a preterm birth or a child of low birth weight increase infant mortality?

    a. *Hypothesis 4a*: The effect of race/ethnicity on infant mortality will be mediated by having an infant who is preterm or low birth weight.

    b. *Hypothesis 4b*: The effect of race/ethnicity on infant mortality will be mediated by having an infant who is preterm or low birth weight. Additionally, the effect of race/ethnicity on infant mortality will differ by the amount of prenatal care a woman received.

Chapter 3: Methodology

Sample

Deaths among infants born in the District of Columbia were identified through District of Columbia death records from 2001-2007 and were linked to birth records in those years. Only infants born to DC residents were included. The birth sample included a total of 56,000 births and 659 deaths. Fifty-two death records that were unable to be linked to birth records were excluded, thus reducing the infant death sample size to 607. The 52 deaths that were excluded were randomly distributed across year and were predominately Black. In addition, infants born to non-residents (n = 62) were removed. This reduced the sample to 55,938 births and 607 deaths.

There was also information missing on individual variables for some cases. These missing cases did not affect the results for the analysis. The number of missing cases for each birth certificate variable utilized in the study is as follows:

- Maternal Race: 0
- Birth weight: 0
- Marital status: 1
- Preterm Birth: 50 (<1% of cases)
- Maternal Age: 71 (<1% of cases)
- Maternal Education: 4,436 (8% of cases)
- 6,929 Adequacy of Prenatal Care: 6,929 (12.4% of cases)

Procedure

Linked Birth/Death Data Set

The purpose of linking the birth and death certificates together is to use variables listed on the birth certificate to allow for a detailed analysis of infant mortality (Johnson-Clarke, 2009). For example, the linkage provides the birth weight of the infant that died; unlinked files either identify the birth weight but not whether the infant died or the reverse – an infant death without information about birth weight. An additional benefit of using the linked birth/death data set is that the race and ethnicity of the infant is provided by the mother at the time of delivery and is considered to be more accurate than the race and ethnicity information that is collected at the time of the infant's death by an informant or observation (MacDorman & Matthews, 2008).

In the dataset utilized for the study, there were some cases with missing data. For the study period of 2001-2007, there were a total of 659 total infant deaths in DC. I was able to successfully link 607 of the infant deaths to their corresponding birth certificate. There were 52 cases of infant deaths with missing birth certificate data, representing 7.9% of the total infant deaths during that period. These cases were missing birth certificate data for a myriad of reasons including: incorrectly recorded birth dates or duplicate certificate numbers. They may also have been born in the preceding year to that of death. The infant mortality rate for DC for the study period prior to excluding those deaths with missing data was 11.8 infant deaths per 1000 live births; after removing the deaths with missing data the rate becomes 10.8 infant

deaths per 1,000 live births . All linked birth/death data were analyzed using SAS. 9.3. The research proposal was submitted to the University of Maryland Human Subjects Review Board. The IRB application was approved and appears in Appendix A.

Neighborhood Level Data

The latest data available from the 2000 Census and DC Office of Planning were summarized using a correlation analysis to determine a neighborhood disadvantage index. Specifically, the variables by ward of residence of the mother included:

- percent of Blacks
- median household income
- percent of vacant housing units in a Ward
- percent of renter occupied housing units
- percent of unemployed people
- percent of people who are currently married.
- percent of residents who are unemployed
- percent of female-headed households

Neighborhood disadvantage index was defined as either low or high levels. To determine the cut-off for neighborhood disadvantage with regards to high versus low levels, a factor analysis was conducted. The factor analysis was used to determine which variables were highly correlated to each other. A standardized factor score (with a mean of 0) was assigned to each individual. Those with a factor score above 1 were considered disadvantaged and those with a score below 1 were considered

advantaged. Factor analysis is a collection of methods used to examine how underlying constructs influence the responses on a number of measured variables (DeCoster, 1998). Measures that are highly correlated (either positively or negatively) are likely influenced by the same factors, while those that are relatively uncorrelated are likely influenced by different factors (DeCoster, 1998). Variables such as percent of people in a ward that were never married, and the average family size were originally considered for inclusion but were not found to be highly correlated and were not included. See Appendix E for the factor analysis utilized in the study.

Data utilized are derived from the official District of Columbia Vital Registration System. Data for Washington DC were collected using the 1989 revision of the U.S. Standard Birth Certificate (Appendix B) and the 2003 revision of the U.S. Standard Death Certificate (Appendix C). Data for the neighborhood disadvantage index were derived from the 2000 Census and the DC Office of Planning.

Definition of Variables

The following definitions of the variables were used. See Appendix D and Table 3 for a further explanation of the variables utilized in the study.

Dependent Variable

Infant Mortality

The dependent variable was defined as the infant mortality rate (imr) in the description of infant mortality by categories of mothers (e.g., Blacks) or, in the regression analysis, whether the child died. Standard definitions were used with the infant mortality rate equal to the number of infant deaths (in a particular category)

divided by the number of live births (in the same particular category) times 1000 to yield a rate expressed in standard units.

Independent Variables

Individual Level Variables

Maternal Race

Maternal race was categorized as reported on the birth certificate. Specifically, the birth certificate records the following races: White, Black, Indian, Chinese, Japanese, Hawaiian, Filipino, other Asian, other races, and unknown. Additionally, the birth certificate collects information on the Hispanic origin of the mother, which lists the following options: Mexican, Puerto Rican, or other Hispanic/Latina origin. For the purposes of analysis, non-Hispanic White, non-Hispanic Black, and Hispanic (White or Black) were analyzed as the main variables of interest. All of the other races were grouped as non-Hispanic "other". For the purposes of analysis, the original variables of race were re-coded as dummy variables.

Community Level Variables

Neighborhood Disadvantage

For the purposes of the study, neighborhood disadvantage index as previously described is defined at the ward level. Ward level data were chosen as the unit of analysis because it represents distinct traditional geo-political communities with the necessary data aggregated at the community level to be considered as a neighborhood. As previously described, a factor-based disadvantage index consisted of 8 census-based indicators:

1. the percent of Blacks in a ward,

2. the percent of residents unemployed,
3. the percent of residents who are married,
4. the percent of vacant housing units,
5. the percent of renter occupied housing units,
6. the median household income,
7. the percent of families in poverty,
8. and the percent of female headed households

The data utilized in the disadvantage index were derived from the 2000 census data, which is the latest available. The factor scores (correlations of indicators with the index) ranged from - 0.59 to 1.47, with a higher score representing higher disadvantage at the ward level.

Mediators of Infant Mortality

Low Birth Weight

Low birth weight was defined dichotomously to reflect either low birth weight (<2500 grams), or normal birth weight (2500 grams or more).

Preterm Birth

Preterm birth was defined dichotomously as no preterm birth (>36 weeks) or preterm birth (<36 weeks) for logistic regression.

Controls

Marital Status

Marital status was defined dichotomously as married or single. Infants born to single mothers have more adverse outcomes than infants born to married mothers across races (Alio et al., 2009).

Maternal Education

Maternal education was defined as less than high school, high school, some college or college degree. Maternal education was dummy coded into separate categories for the logistic regression.

Maternal Age

The review of research showed evidence that infants of teen (<20) and older mothers (<35) have a higher risk of mortality before the age of 1. Additionally, women experience weathering as a result of the cumulative effects of stress and/or racism. To estimate accurately the differences in birth outcomes as experienced by Black and White women, maternal age was defined as: teen (<20 years), early twenties (20-24), late twenties (25-29), early thirties (30-34), and 35 and over. These categories were dummy coded for inclusion in the logistic regression.

Prenatal care

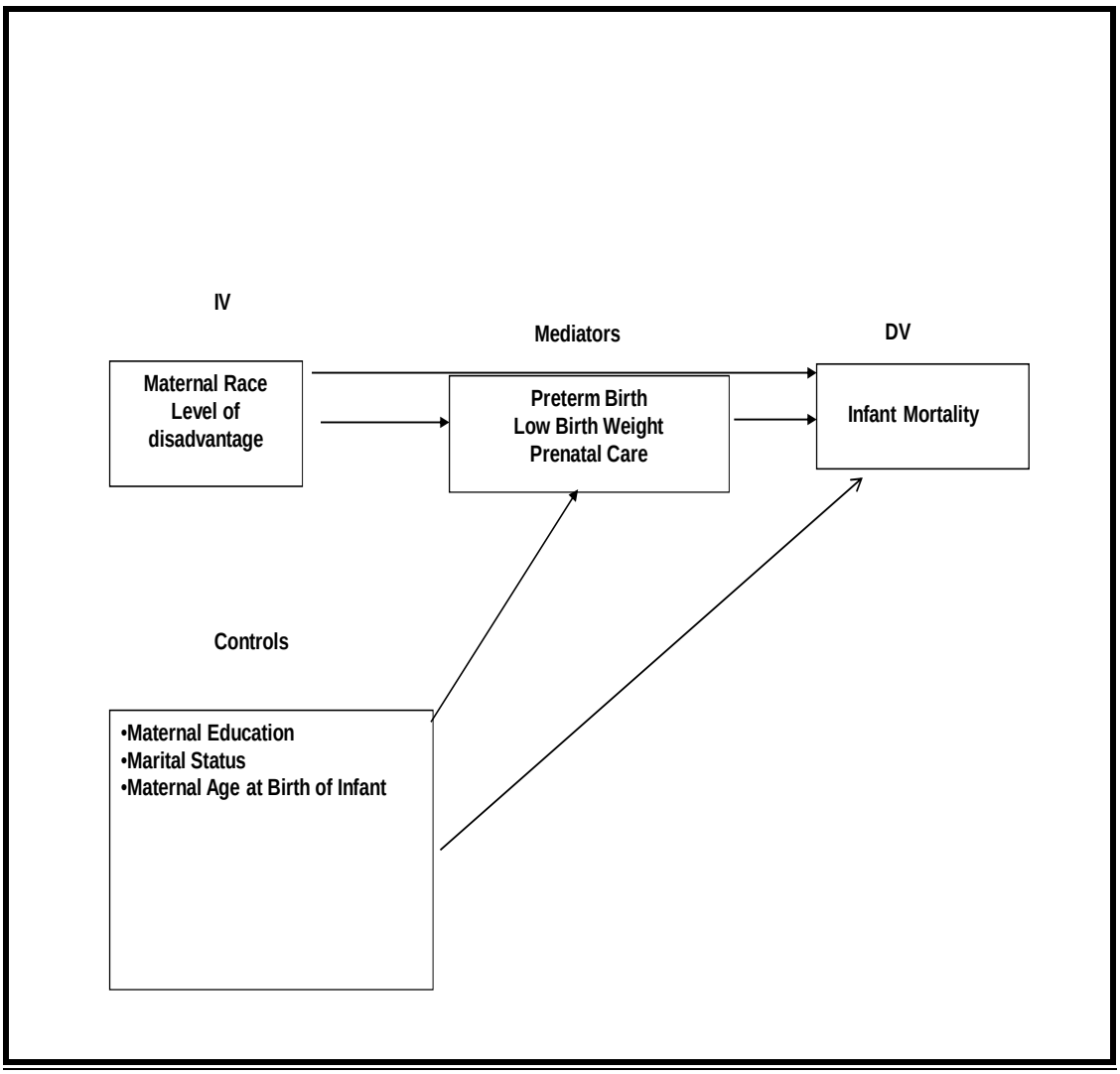
The Kessner Index algorithm requires that to be rated Adequate, prenatal care must begin in the first trimester; to be rated Intermediate, care must begin in the second trimester; and to be rated Inadequate, care must begin in the third trimester or not at

all. The additional factor in the Kessner Index is the number of prenatal care visits (Kotelchuck, 1994).

Modeling

- Dependent Variable - infant mortality
- Independent Variables - maternal race and level of advantage or disadvantage at the ward level
- Control variables - marital status, maternal age, and maternal education.
- Mediators - Preterm birth, low birth weight, prenatal care

Figure 3: Conceptual Model



Data Analysis

In the linked birth/infant death data set, information from the birth certificate is linked to information from the death certificate for each infant less than 1 year of age who was born in Washington DC from 2001 through 2007. Data analysis was conducted using logistic regression to determine race/ethnic differences in the odds of experiencing an infant death given the data collected from the birth certificate.

Logistic regression was chosen because it allows for an analysis of categorical variables as a dependent variable. Additionally, for variables that reflect an increased odds ratio (over 1.00) the odds ratio demonstrates that the likelihood or probability of experiencing an infant death is greatly increased for the variable of interest. The effects of variables such as maternal education, marital status, prenatal care, and whether a family lived in a disadvantaged ward on infant mortality were examined as independent variables as well as controls. For example, if the majority of Black mothers were age <20 yrs old and the White mothers were 25-29 years of age the disparity might be more likely due to age than race. The analysis plan included both individual and neighborhood level risk factors for infant mortality. Examining only individual level risk might overlook the pivotal role that neighborhood level disadvantage plays in influencing poor birth outcomes such as infant mortality, other factors being equal.

Models included the following independent variables: maternal race, maternal age, maternal education, marital status, and level of disadvantage at the ward/neighborhood level. Adjusted odds ratios were estimated with 95% confidence intervals to determine the magnitude of the relationship of infant mortality to each of the independent variables, that is, whether it was more like that a black infant was more or less likely to die before reaching their first birthday than a white infant. A factor-based disadvantage index as previously described that consisted of 8 census-based was used to construct the index. The factor score (correlations of indicators with the index) ranged from - 0.59 to 1.47. Individuals were given scores on these items based upon the ward they lived in. A principle components factor analysis was

used to confirm a one-factor structure. Factor scores were then computed and assigned to individuals. Finally, race/ethnicity and disadvantage were interacted to determine if the effect of the interaction results were stronger for infant mortality than the relationship of race/ethnicity to infant mortality alone. For example, being Black increases the likelihood of infant death, but that "risk" might be lower for Black women living in a Black neighborhood.

Table 3 below lists the variables used for the analysis plan.

Table 3. Variables Used in Analysis

Variable	Type
Individual Level	
Low Birth weight	Categorical
Maternal Age	Categorical
Maternal Education	Categorical
Adequacy of Prenatal Care	Categorical
Marital Status	Dichotomous
Maternal Race	Categorical
Preterm Birth	Categorical
Neighborhood Level	
Renter Occupied Units	Continuous
Vacant housing Units	Continuous
Now Married	Continuous
Unemployment Rate	Continuous
Percent Black	Continuous
Percent of families in Poverty	Continuous
Median Household Income	Continuous
Percent of Female Headed-households	Continuous

Research Question 1

To examine hypothesis (1a) the rates of infant mortality by race were computed by race/ethnicity according to maternal education, marital status, and maternal age. The dependent variable was infant mortality and the independent variables were race/ethnicity, maternal education, marital status, and maternal age. To

examine the second hypothesis (1b) logistic regression was run. The dependent variable was infant mortality, the independent variable was race/ethnicity, and the control variables were maternal education, marital status, and maternal age.

Research Question 2

To test the first hypothesis (2a) whether or not women living in areas of high disadvantage experience higher rates of infant mortality than women living in areas of lower disadvantage, a regression in which the dependent variable is the infant mortality rate and the independent variable is the neighborhood disadvantage index. To test the second hypothesis (2b) a regression is performed in which the dependent variable is the infant mortality rate, the independent variable is the neighborhood disadvantage index, and the control variables are maternal age, marital status, and maternal education.

Research Question 3

The first hypothesis, (3a) tests whether or not the effect of race/ethnicity will differ with regard to infant mortality if the mother lives in an area of high disadvantage as compared to an area with lower rates of disadvantage. The dependent variable is the infant mortality rate, and the independent variable is race/ethnicity. Next, a model including an interaction between the neighborhood disadvantage index and race/ethnicity is run to examine the effect including the effect of the interaction. If the coefficient for the interaction is significant this indicates that the effect of race/ethnicity on infant mortality differs by the disadvantage level of the neighborhood. Models of disadvantage, infant mortality and race/ethnicity with and

without the inclusion of the control variables of maternal education, maternal age, and marital status were run to test hypothesis (3b).

Research Question 4

Hypothesis (4a) was used to test for mediation. To test for mediation, three models were run. Specifically, infant mortality is regressed on race/ethnicity and the percent of disadvantage in the neighborhood. Second the mediators, preterm birth, low birth weight, and prenatal care are regressed on race/ethnicity and level of advantage or disadvantage in the community. Finally, infant mortality is regressed on both independent variables of race/ethnicity and percent of disadvantage in a community and on the mediators, low birth weight, preterm birth, and prenatal care. If the association between race/ethnicity and infant mortality declines when low birth weight, preterm birth, and prenatal care are included then this finding will demonstrate that low birth weight and preterm birth are in fact mediators. Hypothesis (4b) is tested similarly as hypothesis (4a), but a regression between race/ethnicity, disadvantage, and between the mediators of low birth weight, preterm birth, and prenatal care are added to see whether or not the extent of mediation differs from that in hypothesis (4a).

Chapter 4: Results

The primary null hypothesis driving this study is: neighborhood level disadvantage has no effect on the race/ethnicity specific infant mortality rate for infants born to resident mothers controlling for known factors related to infant mortality. This study seeks to determine if there is a possible protective effect or conversely a harmful effect associated with the neighborhood conditions in which the mother lives. This chapter first presents descriptive statistics for the infant births and deaths in the sample and the variables included in the analysis. Next, results of the logistic regression for each of the four research questions and their corresponding significance levels for the results of the individual level and ward-level variables are presented. Finally, odds ratios are presented estimating the likelihood of "neighborhood disadvantage" on Black and Hispanic infant mortality rates as compared to Whites. Additionally, using contextual factors such as the median household income and percent of residents unemployed, an index of neighborhood level disadvantage was created and its influence on infant mortality examined. The estimated odds ratios and their corresponding significance levels for the results of the individual level and ward-level variables are shown in the tables for each research question.

Demographic Characteristics of the Sample

Descriptive statistics were used to determine the frequencies, and standard deviations as appropriate for each variable- dependent variables, independent variables, control variables, and mediator variables.

Additionally, Table 4 shows the total number of births and deaths, and infant mortality rates in the population of the District of Columbia, by year from 2001 to 2007. Blacks had the highest number of infant deaths by year for the study period 2001-2007. Finally, the infant mortality rate for Blacks is higher than the overall infant mortality rate for all races. Table 4 summarizes the distribution of infant deaths, births and infant mortality rate by year and race/ethnicity and exhibits the racial/ethnic disparities.

Table 4- Results of Births, Deaths, and Infant Mortality Rate by Year

INFANT DEATHS	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Total**
All	76	84	72	86	91	92	106	607
Non-Hispanic White	5	9	1	2	6	6	8	37
Non-Hispanic Black	64	64	64	73	73	79	80	497
Non-Hispanic Other	3	1	0	0	2	3	5	14
Hispanic	4	10	7	11	10	4	13	59
BIRTHS	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Total**
All	7613	7485	7611	7934	7937	8490	8868	55938
Non-Hispanic White	1608	1692	1810	1967	2013	2091	2202	13383
Non-Hispanic Black	4721	4508	4538	4655	4552	4797	4889	32660
Non-Hispanic Other	279	286	289	285	240	259	290	1928
Hispanic	1005	999	974	1027	1132	1343	1487	7967
IMR By Race[1]	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	
All	10.0	11.2	9.5	10.8	11.5	10.8	12.0	
Non-Hispanic White	3.1	5.3	0.6	1.0	3.0	2.9	3.6	
Non-Hispanic Black	13.6	14.2	14.1	15.7	16.0	16.5	16.4	
Non-Hispanic Other	10.8	3.5	0.0	0.0	8.3	11.6	17.2	
Hispanic	4.0	10.0	7.2	10.7	8.8	3.0	8.7	

Note: Infant Mortality rate (IMR) = number of infant deaths/1,000 live births

Table 5 describes the demographic variables for the entire sample.

- Blacks make up the majority of the sample representing 58.1%
- Whites comprise 24%,
- Hispanics 14.2% and the
- “Other” race category 3.4%.

The majority of the sample has a high school education or above, representing 78% of the sample; however, 21.3% of the sample has less than a high school diploma. The majority of the sample is between the ages of 20-34, and represents 66% of the sample. The percentage of births to teens (<20 years old) is 12% and the percentage of births to women ages 35 and over is 20%. The percentage of preterm birth, low birth weight and inadequate prenatal care in the overall sample is 8% for each of the variables. Forty-three percent of the sample was married.

Table 5. Demographic Maternal Characteristics, Birth Weight and Infant Mortality by Percent

(*n* = 55,938)

Variable	% of Sample
Hispanic	0.14
Black	0.58
White	0.24
Other	0.03
Less than high school	0.21
High School	0.32
Some College	0.13
College	0.33
Age Group	
<20	0.11
20-24	0.22
25-29	0.21
30-34	0.23
35+	0.19
Married	0.43
Low birth weight	0.08
Very Low birth weight	0.02
Preterm Birth	0.08
Inadequate Prenatal Care	0.08
Intermediate Care	0.23

Note: Percentages reported in decimals.

The sample includes a total of 55,938 observations and 607 deaths between the years 2001 and 2007. Tables 6a, 6b, 6c and 6d provide descriptive information by race/ethnicity. Race/ethnicity variables are reported for Black, White, Hispanic and the other race category. With regards to demographic background, 21.4% of Blacks have completed less than a high school degree, compared to 1% of Whites, 60% of Hispanics, and 16% of those classified as "other". White mothers in the sample have the highest education levels, with 87.8% having a college degree, followed by 52% of the mothers in the other race category, 13% of Blacks, and 8% of Hispanics. With regards to marital status, White women in the study have the highest proportion married, 94%, followed by the other race category, 79%, Hispanics, 36%, and Blacks, 22%.

With regards to birth outcomes results, the Black population has the highest number of births to mothers less than 20 years of age (17%). Conversely, Whites have the lowest percentage of teen births, at 1% of the population. White mothers have the highest percentage of births to women over 35, with 41% of the births to these women in that age range. The disparity between Blacks and Whites with regards to low birth weight and preterm birth continues to exist, with 11% of the infants in the Black population born low birth weight, and 5% of the infants in the White sample born low birth weight. Similar results are seen when comparing rates of preterm birth among Black and White populations. Ten percent of Black infants are born premature compared with 5% of White infants. The rates of preterm birth are 6% in both the Hispanic and other race category.

Table 6a. Percentages For All Variables By White Race (n = 13,383)	
Variable	% of Sample
Education	
less than high school	0.01
High school	0.04
Some college	0.06
College	0.87
Age	
<20	0.006
20-24	0.03
25-29	0.13
30-34	0.41
35+	0.41
Birth Weight	
Low birth weight	0.05
Very Low birth weight	0.01
Preterm Birth	
Preterm	0.05
Adequacy of Prenatal Care	
Inadequate	0.02
Intermediate	0.11
Married	0.93

Note: percentages reported as decimals.

Table 6b. Percentages For All Variables By Black Race (n = 32,660)	
Variable	% of Sample
Education	
< high school	0.21
High school	0.47
Some college	0.17
College	0.13
Age	
<20	0.16
20-24	0.30
25-29	0.23
30-34	0.17
35+	0.12
Birth Weight	
Low birth weight	0.10
Very Low birth weight	0.03
Preterm Birth	
Preterm	0.10
Adequacy of Prenatal Care	
Inadequate	0.11
Intermediate	0.27
Percent Married	0.22

Note: Percentages reported as decimals

Table 6c. Percentages For All Variables By Hispanic Ethnicity (*n* = 7,967)	
Variable	% of Sample
Education	
less than high school	0.59
High school	0.25
Some College	0.06
College	0.08
Age	
<20	0.12
20-24	0.28
25-29	0.28
30-34	0.18
35+	0.11
Birth Weight	
Low birth weight	0.06
Very Low birth weight	0.01
Preterm Birth	
Preterm	0.06
Adequacy of Prenatal Care	
Inadequate	0.07
Intermediate	0.32
Married	0.35

Note: Percentages reported as decimals

Table 6d.Percentages For All Variables By Other Races (n = 1,928)	
Variable	% of Sample
Education	
less than high school	0.15
High school	0.19
Some College	0.12
College	0.52
Age	
<20	0.03
20-24	0.12
25-29	0.24
30-34	0.34
35+	0.25
Birth Weight	
Low birth weight	0.06
Very Low birth weight	0.01
Preterm Birth	
Preterm	0.05
Adequacy of Prenatal Care	
Inadequate	0.05
Intermediate	0.21
Married	0.79

Note: Percentages reported as decimals

Research Question 1

The following hypotheses were tested: a) Rates of infant mortality will differ by race and by maternal factors such as maternal education, marital status, and maternal age and b) Controlling for maternal education, maternal age, and marital status, women will experience different rates of infant mortality by race.

Table 7 displays the results of the analysis. Blacks have the largest rate of infant mortality, at 15.2 per 1,000 followed by Hispanics at 7.4 per 1,000, the "other" race category at 7.3 per 1,000 and Whites at 2.8 per 1,000. The chi-square statistics for Whites, Blacks (< .0001), and Hispanics (< .05) were all statistically significant. Additionally, for the education variables, the percentage of infants who died varied with the level of mothers' education. For instance, at the less than high school level, the infant mortality rate was 9.7 per 1,000 live births, but for those with a college degree, the infant mortality rate was 4.0 per 1,000. The results for education are significant at the < .0001 level. The age category results did not substantiate some of the previous research on infant mortality. Teen mothers (< 20 years old) had the highest rates of infant mortality at (14.3 per 1,000). The lowest infant mortality rate is seen in the oldest age category of women in the sample 30 and over 8.6 per 1,000 experienced an infant death. The results for age are statistically significant at the < .05 level. The results reveal that women who are not married have higher rates of infant mortality, at 14.9 per 1,000 with 5.5 per 1,000 infant mortality rate for women who are married. The results for marital status are significant at the < .0001 level.

Table 7. Infant Mortality by Maternal Characteristics and Disadvantage (Rate and Chi-Square)

Variables	Infant Mortality Rate/1000	Chi Square Probability	Sample Size
Race			55,938
Black	15.2	<.0001***	32,660
Hispanic	7.4	0.018 **	7,967
Other	7.3	0.0202*	1,928
White	2.8	<.0001***	13,383
Education			51,502
<hs	9.8	<0.0001 ***	10,970
high school	3.7	<0.0001 ***	16,769
some college	1.3	<0.0001 ***	6,697
college	4	<0.0001 ***	17,066
Age			55,867
Teen	14.3	<0.0002**	6,693
Early 20's (20-24)	12.5	<0.0002**	12,795
Late 20's (25-29)	11.3	<0.0002**	12,118
Early 30's (30-34)	8.6	<0.0002**	13,217
35+	8.6	<0.0002**	11,044
Marital Status			55,937
Not Married	14.9	<.0001***	31,667
Married	5.5	<.0001***	24,270
Disadvantage Index			55,938
Not advantaged	12.6	<.0001***	36,006
Advantaged	7.7	<.0001***	19,932

**p<.05 ** p<.01 ***p<.0001*

Table 8 presents the results of question 1, hypotheses A and B, analyzed using a logistic regression. The two hypotheses being tested in research question 1 are: 1a) infant mortality will differ by race /ethnicity and by maternal factors such as maternal education, marital status, and maternal age, and 1b) Controlling for maternal education, maternal age, and marital status, women will experience different rates of infant mortality by race. In the first model, infant mortality is regressed on race and Hispanic ethnicity. The odds ratio indicates that Black race and Hispanic ethnicity are both associated with greater infant mortality. Thus, hypothesis 1a is supported by the results of the first model. The second model for research question 1b included race/ethnicity and the control variables of marital status, maternal education, and maternal age. The results of the second model indicate that race is statistically significant for Black and Hispanic ethnicity even when maternal education, maternal age and marital status are added to the model there was an increased risk of infant mortality for Black race and Hispanic ethnicity.

Table 8. Odds Ratios for Infant Mortality by Race, Maternal Age, Maternal Education, and Marital Status
(*N* = 607)

	Model I		Model II	
Race				
Black	5.57	***	3.01	***
Hispanic	2.69	***	1.70	*
Other	2.64	*	1.63	
Non-Hispanic White	reference		reference	
Maternal Age				
Teen <20			reference	
Early Twenties (20-24)			0.96	
Late-Twenties (25-29)			0.87	
Early Thirties (30-34)			0.98	
Oldest (35 and older)			1.17	
Maternal Education				
less than high school			reference	
high school			1.06	
some college			1.01	
college			0.79	
Marital Status				
Married			0.71	**
Log Likelihood				
6698.82	6518.64		4869.57	

*Note: *p<.05 ** p<.01 *** p<.0001*
Scores are reported as odds ratios.

Research Question 2

Logistic regression is used to examine hypothesis 2a whether- or not women living in areas of high disadvantage experience higher rates of infant mortality than women living in areas of lower disadvantage independent of race. Specifically, hypothesis 2a states that a woman living in a place of high disadvantage as compared to a place of low disadvantage will have an increased risk of infant mortality. Table 9 displays the results of 2a and 2b.

With regard to hypothesis 2a, the relationship between living in areas of high disadvantage and infant mortality is statistically significant at the <.0001 level. For women living in a disadvantaged neighborhood, results indicated a higher risk of infant mortality; thus hypothesis 2a was supported. To test the second hypothesis in research question 2, the independent variables of race and the control variables were added to form the second model. The analysis reveals that when Black race and Hispanic ethnicity are added to the model, Black and Hispanic are statistically significant at the < .0001 level. The odds ratio for disadvantage decreases from 1.651 in the first model to 1.149 in the second model albeit no longer achieving statistical significance. The odds ratio for disadvantage decreases from 1.651 in the first model to 1.149 in the second model and disadvantage is no longer significantly related to infant mortality.

Thus, hypothesis 2b was not supported in the results, in that women living in areas of disadvantage no longer had an increased risk of infant mortality after the inclusion of the control variables. This finding suggests that, once the race and ethnicity of the mother are considered, the odds of infant mortality are no longer

higher in neighborhoods that are disadvantaged compared to those that are advantaged.

Table 9. Race, Demographic Variables, and
Neighborhood Level Disadvantage as
predictors of Infant Mortality

	Model I		Model II	
Race				
Black			2.92	***
Hispanic			1.71	*
Other			1.63	
Non-Hispanic White			reference	
Disadvantage Index				
Factor Score for Disadvantage	1.65	***	1.15	
Maternal Age				
Teen <20			reference	
Early Twenties (20-24)			0.96	
Late-Twenties (25-29)			0.87	
Early Thirties (30-34)			0.99	
Oldest (35 and older)			1.18	
Maternal Education				
less than high school			reference	
high school			1.06	
some college			1.02	
college			0.80	
Marital Status				
Married			0.71	**
Log Likelihood 6700.88	6668.18		4868.25	

*Note: *p<.05 ** p<.01*** p<.0001*
Scores are reported as odds ratios.

Research Question 3

Logistic regression is used to test hypothesis 3a -the relationship of race/ethnicity to infant mortality if the mother lives in a disadvantaged neighborhood. The race/ethnicity variables were interacted with disadvantage to determine the odds of infant mortality for a racial or ethnic minority mother living in a disadvantaged neighborhood. Specifically, race/ethnicity, disadvantage, and their interaction were tested simultaneously to determine if there was a combined effect on infant mortality. Finally, to test hypothesis 3b, the control variables of maternal age, maternal education, and marital status were added to the third model. Table 10 reveals the results of hypothesis 3a and 3b. Model 1 displays the results for disadvantage controlling only for race and Hispanic ethnicity. Black race and Hispanic ethnicity are statistically significant (< .0001) and "other" race is significant at the < .01 level. The disadvantage index is not significant in this model. These results show no association between disadvantage at the community level and infant mortality when race and ethnicity are controlled.

The next model includes the effects of race, disadvantage, and the interaction of race and disadvantage on infant mortality. Model II results are statistically significant for Black, Hispanic and other race. Disadvantage is now significant at p <.05. The results of the interactions of race and disadvantage are not statistically significant for Blacks; however they are significant for Hispanics at p< .05. Thus, hypothesis 3a is partially supported in model II. Model III testing the main hypothesis of this study includes the control variables. In this model the interactions between

Black race and disadvantage and Hispanic ethnicity and disadvantage are significantly associated with lower infant mortality ($p<.001$ and $p<.05$, respectively). . Table 11 shows infant mortality by Ward and Race/Ethnicity. Wards 7 and 8 have the highest rate of infant mortality of all of the wards, in addition to having the highest concentration of Black infant deaths. Additionally, Wards 1 and 3 have the lowest rates of infant mortality of all the wards in addition to having the lowest rates of infant deaths for White infants.

Table 10. Race, Demographic Characteristics and Neighborhood Level Disadvantage as predictors of infant mortality

	Model I		Model II		Model III	
Race						
Black	5.39	***	6.70	***	3.10	***
Hispanic	2.66	***	3.78	***	2.04	*
Other	2.62	**	2.55	*	1.62	
Non-Hispanic White	reference		reference		reference	
Neighborhood Disadvantage						
Factor Score for Disadvantage	1.08		1.69	*	1.34	
Interaction of Race and Factor						
Black * Disadvantage			0.63		0.87	*
Hispanic* Disadvantage			0.48	*	0.70	*
White*Disadvantage			reference		reference	
Maternal Age						
Teen <20					reference	
Early Twenties (20-24)					0.96	
Late-Twenties (25-29)					0.87	
Early Thirties (30-34)					0.99	
Oldest (35 and older)					1.18	
Maternal Education						
less than high school					reference	
high school					1.06	
some college					1.02	
college					0.81	
Marital Status						
Married					0.72	**
Log Likelihood 6698.88	6517.97		6514.15		4867.557	

p<.05 p<.01*** p<.0001*

Note: The Disadvantage Index includes : median household income, percent of Blacks in a ward, % of female headed households, % of residents now married, % of unemployment, % of families in poverty, % of renter occupied housing and % of vacant housing units. The table reports scores as odds ratios.

Table 11. Infant Mortality by Ward and Race

IMR by Ward	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	Total
Births per Ward	7992	5340	6460	7979	5938	6269	6626	8727	55331
Deaths per ward	66	51	15	87	84	67	104	133	**607**
Ward- Level IMR	8.25826	9.550562	2.321981	10.90362	14.14618	10.68751	15.69574	15.24006	
Death by Race and Ward	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	Total
All Births	8058	5391	6475	8066	6022	6336	6730	8860	55938
Deaths per ward	66	51	15	87	84	67	104	133	**607**
Non-Hispanic White	9	6	11	1	0	8	0	2	37
Non-Hispanic Black	32	36	4	57	81	57	102	128	497
Non-Hispanic Other	0	5	0	1	2	1	2	3	14
Hispanic	25	4	0	28	1	1	0	0	59

Research Question 4

The final research question examined the relationship of race/ethnicity and the mediators of low birth weight, preterm birth, and adequacy of prenatal care to infant mortality. Hypothesis 4a states that the effect of race/ethnicity on infant mortality will be mediated by having an infant who is preterm or low birth weight. To test hypothesis 4A, race/ethnicity alone was regressed on infant mortality in the first model found in Table 12. The results are statistically significant for Blacks and Hispanics at the <.0001 levels (odds ratio = 5.57 and 2.69, respectively) and the other race at the .01 level (odds ratio = 2.64). In the second model, preterm birth and birth weight were added to the model. The results are statistically significant for Black race and Hispanic ethnicity at the < .0001 level, and the other race at the <.01 level. In model II the results are significant for low birth weight (< .0001) and preterm birth (< .01) level thus supporting the hypothesis that having a low birth weight or preterm baby increases the risk of infant mortality. When low birth weight and preterm birth were added to the model, the odds ratios of death for Black infants dropped to 2.82 and that for Hispanics dropped to 2.46 and the results remain statistically significant.

Thus hypothesis 4a is supported. Model III included race/ethnicity, preterm birth, birth weight and adequacy of prenatal care. The results for this model are statistically significant for Black race and Hispanic ethnicity, but not for other race. The likelihood of infant mortality decreased for Blacks from 2.82 to 2.30 and decreased for Hispanics from 2.46 to 2.02. The results are statistically significant for low birth weight (< .0001) preterm birth (< .01), and intermediate prenatal care ($p<.05$). Hypothesis 4b is supported. Model IV includes race/ethnicity, preterm birth, and low birth weight, adequacy of prenatal care, maternal age, maternal education, and marital status. The results are significant for Black race, maternal age (late twenties and over 35) at the < .05 level. Additionally the results are significant at the < .0001 level for low birth weight and at the <.01 level for preterm birth and intermediate care. Furthermore, the likelihood of infant mortality declined for Blacks from 2.30 to 1.57, remaining significant, and for Hispanics declined from 2.04 to 1.50 but was no longer significant. The results indicate that low birth weight, preterm birth, and the adequacy of prenatal care are mediators of the relationship of race/ethnicity to infant mortality. Interestingly, in model III the results were only significant for intermediate care and not inadequate care. For a variable to be considered a mediator, it should be directly related to the dependent variable and, when included in the model, alter the association between the independent and dependent variable. As evidenced in the results, the odds of infant mortality for Blacks and Hispanics changed substantially when the mediator variables were added to the model, though they continued to be statistically significant. All three variables – low birth weight, preterm birth, and inadequate prenatal care mediated the effect of race and ethnicity on infant mortality.

Table 12. Demographic Factors, Birth Weight, Preterm Birth, and Adequacy of Prenatal Care as Predictors of Infant Mortality

	Model I		Model II		Model III		Model IV	
Race								
Black	5.57	***	2.82	***	2.30	***	1.57	*
Hispanic	2.69	***	2.46	***	2.04	**	1.50	
Other	2.64	**	2.04	*	1.80		1.30	
Non Hispanic White	reference		reference		reference		reference	
Preterm Birth								
Preterm Birth			1.7	**	1.71	**	1.89	**
Birthweight								
Low Birthweight			3.41	***	3.35	***	3.03	***
Normal Birthweight			reference		reference		reference	
Adequacy of Prenatal Care								
inadequate					1.17		1.00	
intermediate					1.87	***	1.37	**
good					reference		reference	
Maternal Age								
Teen <20							reference	
Early Twenties (20-24)							0.92	
Late-Twenties (25-29)							0.71	*
Early Thirties (30-34)							0.70	
Oldest (35 and older)							0.66	*
Maternal Education								
less than high school							reference	
high school							1.04	**
some college							0.96	**
college							0.93	**
Marital Status								
Married							0.84	
Log Likelihood 6698.88	6518.638		4296.40		4253.76		3444.48	

*Note: *p<.05 ** p<.01 *** p<.0001* Scores are reported as odds ratios

The following table provides a summary of the four research questions in this study.

Table13. Summary of Results

Research Question and Hypothesis	**Results**
1) Do women experience different rates of infant mortality by race?	Supported. The rates of infant mortality for Black race and Hispanic ethnicity were significant in all of the models. Specifically, the odds ratios for infant mortality for Blacks and Hispanics were higher than that of Whites.
Hypothesis 1a: Rates of infant mortality will differ by race and by maternal factors such as maternal education, marital status, and maternal age.	Supported. Rates of infant mortality differed by maternal factors such as maternal education and marital status. Additionally, the odds ratio for infant mortality decreased with education level and marital status.
Hypothesis 1b: Controlling for maternal education, maternal age, and marital status, women will experience different rates of infant mortality by race.	Supported. The rates of infant mortality differed by race after controlling for the control variables of maternal education, marital status and maternal age.
2) Do women living in areas of high disadvantage experience higher rates of infant mortality than women living in areas of low disadvantage?	Supported. Women living in areas of high disadvantage experienced higher rates of infant mortality.
Hypothesis 2a: A woman in a place of high disadvantage as compared to a place of low disadvantage will have an increased risk of infant mortality.	Supported. A woman in a place of high disadvantage has a higher risk of infant mortality.
Hypothesis 2b: A woman in a place of high disadvantage will have an increased risk of infant mortality after controlling for marital status, maternal education, and maternal age.	Supported. A woman living in a place of high disadvantage has an increased risk of infant mortality after adding the control variables of marital status, maternal education and maternal age.
3) Does the effect of race/ethnicity on infant mortality differ if the mother lives in a place of high disadvantage versus low disadvantage?	Supported. The effect of race/ethnicity differed if the mother lived in an area of high disadvantage.
Hypothesis 3a: The effect of race/ethnicity will differ with regard to infant mortality if the mother lives in an area of high disadvantage as compared to an area with lower rates of disadvantage.	Supported. The interaction of Hispanic ethnicity and disadvantage was statistically significant. The results showed that the effect of being Black or Hispanic was smaller in areas of greater disadvantage. The effect of race/ethnicity shows a decreased odds ratio for infant

	mortality when interacted with disadvantage.
Hypothesis 3b: Controlling for maternal education, marital status, and maternal age, the effect of race/ethnicity will differ in areas of high poverty versus low disadvantage.	Supported. After controlling for maternal education, marital status, and maternal age the interactions of race/ethnicity and disadvantage remained significant.
4) Will having a preterm birth or a child of low birth weight increase infant mortality?	Supported. Having a low birth weight or a preterm infant birth increased the risk of infant mortality. The results did indicate a meditational effect of preterm birth and low birth weight on the relationship between race and infant mortality.
Hypothesis 4a: The effect of race on infant mortality will be mediated by having an infant who is preterm or low birth weight.	Supported. Low birth weight and preterm birth meditated the effect race/ethnicity on infant mortality. The odds ratio for infant mortality declined after the addition of low birth weight and preterm birth.
Hypothesis 4b: The effect of race/ethnicity on infant mortality will be mediated by the amount of prenatal care a woman received.	Supported. The odds ratio for Blacks and Hispanics declined when adequacy of prenatal care was added to the model. Additionally, prenatal care was related to infant mortality though the results were not statistically significant for inadequate care, just intermediate care. Therefore, the adequacy of prenatal care appeared to be a mediator for the association between race/ethnicity and infant mortality, but not exactly as anticipated.

Chapter 5: Discussion

The current study utilized the ecological theory and the social determinants of health theory to examine predictors of infant mortality in Washington DC. This study extends public health knowledge about contextual and neighborhood influences on health disparities and adverse birth outcomes. This research is meaningful to maternal and child health for multiple reasons.

First, the research highlights the complexities of the urban environment that is Washington DC. The usage of data at the ward level allows for an examination of the unique differences of individuals and communities with regards to demographics on race, marriage, education, and age. Second, this study expands previous research conducted on the benefits of using multiple levels of data to obtain a clearer and more specific picture of the relationship between one or many independent variables and a dependent variable of interest. Furthermore, this study examines low birth weight, preterm birth and the adequacy of prenatal care as mediators of infant mortality to examine their protective, null, or increased role in the likelihood of infant mortality for Washington DC. Finally, unlike other studies that have examined infant mortality and health disparities, this study also examined race by: 1) studying the interaction of race/ethnicity at the individual level with neighborhood disadvantage at the ward level, and 2) studying the relationship of race/ethnicity at the individual level, the control variables of maternal age, marital status and maternal education at the individual level, and neighborhood disadvantage at the ward level with infant mortality.

Characteristics of the Sample

The major goal of this study was to examine the relationship of race/ethnicity and neighborhood level disadvantage to infant mortality in Washington DC. With regards to the observations in the sample, 58% of the women in the study were Black, 24% White, 14% Hispanic, and 3% other. Having such a large number of Blacks in the study is a unique advantage in the study of race and health disparities because Blacks are often underrepresented in our samples. There were other contextual factors that influenced the results of the study in addition to race. For example, almost 90% of Whites in the sample had a college degree, compared with 60% of Hispanics with less than a high school diploma. With regards to Blacks, 21.4% had less than a high school education, and 13.3% had a college degree. Other variables that influenced infant mortality outcomes were the large number of White women over the age of 35 having children, (41%) and the large number of black women under the age of 20 having children (17%). Maternal age is an important indicator of birth outcomes, and previous research has shown that teen mothers are at highest risk for infant mortality, as was further substantiated in the current study (Geronimus, 1996). No support was found for a higher rate of infant mortality among older mothers, however.

Predictors of Infant Mortality (Dependent Variable) in Washington DC

The variables utilized at the individual level include: maternal race, maternal age, maternal education, marital status, low birth weight, preterm birth, and prenatal care. Variables utilized at the community level include: the percent of renter owned units, the percent of vacant housing units, the percent of people now married, the

unemployment rate, the percent of Blacks in a ward, the percent of families in poverty and the median household income in a ward.

Independent Variables

Maternal Race

A major goal of this research is to examine the relationship between maternal race, neighborhood disadvantage and infant mortality. The overall research question stated that infant mortality would differ by race/ethnicity. As hypothesized, maternal race proved to be an important indicator of infant mortality in Washington DC. Specifically, for Blacks, the rate of infant mortality was 15.2 per 1,000. For Whites, the overall rate of infant mortality was 2.8 per 1,000. Hispanics, the third largest racial/ethnic group, reported a 7.4 per 1,000 rate of infant mortality. According to the literature review that was conducted, Blacks have the highest rates of infant mortality and experience the most adverse birth outcomes (Collins et.al, 2009a). Conversely, Whites have the lowest rates of infant mortality. Thus this study substantiated previous research on infant mortality and race/ethnicity. Hispanics have been shown to have better birth outcomes than Blacks (MacDorman & Matthews, 2009a) and this was substantiated in this study.

Disadvantage Index

It was hypothesized that living in a disadvantaged neighborhood would have a direct impact on the rates of infant mortality, such that women in disadvantaged areas would have higher infant mortality. A large body of previous research supported research question 2 and its corresponding hypothesis on disadvantage and infant mortality,

including earlier work from Collins (2009a) and Roux (2001a). As evidenced by previous research, the percent of infant deaths was lower in those neighborhoods considered advantaged, (7.7%) than in those neighborhoods considered disadvantaged (12.6%). With regards to the regression results, the disadvantage index was statistically significant at the $p<.05$ level when infant mortality was regressed on it in addition to race and with the interaction of race and disadvantage. Specifically, when disadvantage was regressed on infant mortality by itself, the results showed 69% higher odds for infant mortality. The interaction between disadvantage and race/ethnicity however, was negative. Black and Hispanic families living in a disadvantaged area actually had lower odds of infant mortality than those living in a more advantaged area. This finding is in direct contrast to previous research. Collins et.al (2009a) found that racial/ethnic minorities living in neighborhoods of disadvantage had a greatly increased risk of infant mortality.

The current research found a protective effect for minority women living in disadvantaged neighborhoods. The protective effect seen in minority populations could be in the form of community resources such as neighborhood groups, extended family ties, and informal social networks where older residents/grandparents are an integral part of the child rearing process. In particular, Hispanic families often live with extended family members who may be providing the kinds of support to young mothers in particular that could reduce infant mortality risk. In contrast, for those living in more advantaged areas, the kinds of familial and other social networks may not be institutionalized to provide readily available supports. Hence, further

exploration of these racial/ethnic differences need to be explored further in order to best inform programs and policy makers.

Control Variables

Maternal Education

It was hypothesized that maternal education would play a role in the risk of infant mortality and thus it was controlled in the analysis. The results for infant mortality with regards to education show significantly different rates for those with a high school education, (11.4 per 1,000), some college (9.9 per 1,000), or college degree (4.0 per 1,000). For those with less education, there appears to be increased odds of infant mortality. Maternal education is an important indicator of future birth outcomes such as infant mortality due to the increased access to information and resources that education provides. It is consistent world-wide that women with more education have better health outcomes and better family well-being.

Hence, it is incumbent that public health and the education system be encouraged and supported to develop joint initiatives targeted for young girls that stress the relationship between continued education and improved health and life circumstances. Such activities could be in the form of public health announcements, school-based health/education campaigns, parent association initiatives, or materials offered through health clinics and physician offices. All of these actions could emphasize that for mothers who have higher levels of education, there is a greater likelihood of having larger amounts of disposable income, better living arrangements, safer neighborhoods, and an overall better quality of life.

Maternal Age

It was hypothesized that maternal age would influence the likelihood of infant mortality in the study and thus age was controlled in the analysis. The highest rate of infant mortality was for women under the age of 20, an overall death rate of 14.3 per 1,000. The lowest rates of infant mortality were seen in women over the age of 30 who had rates of infant mortality at 8.6 per 1,000 for 30-34 year olds, and 8.6 per 1,000 for women over 35 years old. The majority of Black women in the study bore children at younger ages when compared to Whites. For Blacks, 53% bore children between the ages of 20-29 and 17.8% of Blacks had children under the age of 20. As evidenced in the present study, Blacks, who tend to have children at younger ages, had higher infant mortality rates than Whites. Thus, physicians and programs that work with Black women should pay close attention to the important role that young age plays in birth outcomes. Even though age was not statistically significant in the regression analyses that included controls, young age may contribute to the higher rate of infant mortality among Black women but could not be separated from the racial/ethnic variable in the analyses.

Marital Status

The results of the frequency and chi-square analysis reveal a larger rate of women who were unmarried experiencing an infant death, at 14.9 per 1,000 compared to 5.5 per 1,000 of married women. With regards to the logistic regression, marital status was significant in most of the models, except for research question 4. The implications of these results could be attributed to having a support network during pregnancy for the expectant mother, greater financial resources as a result of a

dual income, and less household and personal stress. Therefore, physicians and midwives should recognize the important part played by the father of the child in the health of the mother during pregnancy. The data in this study supports the fact that having a partner and other support people creates a potentially safer environment for a healthy pregnancy, and this notion should be encouraged in health education classes for high school and college students in preparation for future motherhood.

Prenatal Care

In research question 4, adequacy of prenatal care was added to the existing variables of race/ethnicity, preterm birth, and low birth weight. Low birth weight and preterm birth continue to be risks for infant mortality, low birth weight and preterm infants showing a continually increased risk of infant death. The results suggest that for infants who receive an inadequate level of prenatal care, there is a 17% increased risk of infant death, although this variable is not statistically significant. The adequacy of prenatal care does play a role in infant mortality. For those who received intermediate prenatal care, there was an 87% and 37% increased risk of infant mortality, as seen in models 3 and 4 for research question 4. These findings have meaning for physicians and public health researchers. Specifically, care must be very good, not just intermediate in adequacy. There was a limitation to the measurement of the adequacy of prenatal care. As seen in the present study, there were large numbers of cases missing data on prenatal care. This presents an opportunity to improve the reporting and collection of prenatal care utilization for medical professionals, to allow for a more accurate assessment of how prenatal care affects infant mortality rates. Further research is necessary to examine why intermediate

prenatal care is statistically associated with increased infant mortality but inadequate care is not. This contrast could perhaps be related to the accuracy of the measurement of intermediate care. For example, receipt of little to no prenatal care is clearly defined. However, the measurement of intermediate care may have some ambiguity in terms of the number of prenatal visits or the number of weeks a woman receives care. It is also important to note that both intermediate and inadequate care in the study show increased odds for infant mortality, though only the former is statistically significant. Therefore, it seems that receiving good prenatal care has the lowest odds of infant mortality.

Mediator Effect of Birth Weight, and Preterm Birth on Infant Mortality

In research question 4 it was hypothesized that low birth weight, preterm birth, and the adequacy of prenatal care would explain the relationship of race/ethnicity to infant mortality by acting as a mediator. This hypothesis was supported. The findings suggest that the odds of infant mortality for Black race and Hispanic ethnicity decline as preterm birth, low birth weight, and adequacy of prenatal care are added to the model. The variables of preterm birth and low birth weight are important in the study of infant mortality because they provide insight into the many physiologic, societal, and contextual factors that affect a woman's health and birth outcomes, thus placing her at higher or lower risk for infant mortality.

Previous research in this area has demonstrated that there are racial and ethnic disparities in low birth weight and preterm birth that could benefit from additional research on the stressors or effects of racial disparity on infant mortality (Collins et.al, 2009b). The implications for low birth weight and preterm birth as mediators in this

study provide a foundation for future research on urban mothers who may experience personal and familial stress, unstable housing situations or employment, and unsafe environments which may contribute to preterm deliveries or low birth weight infants.

Summary

This study further substantiates the need for modeling based on theories such as ecological theory and the social determinants of health theory, which both emphasize the need to consider a person and the positive or negative influences of their physical, family, social or political environment on their health. The study builds on previous research conducted with neighborhood level data, race/ethnicity and infant mortality as seen in the work of Collins (2009a) and Roux (2001a). For Blacks and Hispanics there was a greatly increased odd for infant mortality. Moreover it is clear from this study that neighborhood matters; how and to what extent need further study.

Limitations

The current findings, while important to the maternal and child health field, urban health disparities, multilevel modeling and the influence of contextual factors on infant mortality, have limitations that need to be acknowledged. First, a major limitation of secondary data is the measurement and collection of information, such as prenatal care utilization. Due to the large amount of missing data for prenatal care, the results may potentially be biased. Another limitation is that the information while useful to the District of Columbia health official's has limited generalizability. As such, findings may only be generalized to similar urban environments with a similar

timeframe. Additionally, the main focus of the study was on Blacks, Hispanics, and Whites; work on the effect of race/ethnicity and infant mortality with other races would warrant additional research. It should also be recognized that low birth weight and preterm birth are overlapping conditions. In future work it would be desirable to separate these categories. Therefore one should recognize that there may be an overestimate of the effect of these variables in this study.

In addition, the complexity of using population based data by linking data sets, combining data from several sources, and the attention to detail and rigor required for accuracy and multilevel modeling is appreciated and must be incorporated into all analytic efforts. Even with the aid of computer technology and advanced analytic methods, traditional public health measures and metrics must be employed to assure accuracy and understanding of findings. These last items are not limitations per se, rather they are more like lessons learned, that if not applied they could threaten the validity and reliability of any study and become a limitation.

Finally, because of the overwhelming disparity between Blacks and Whites in this sample, the research was unable to explore all of the neighborhood level effects (advantage/disadvantage) on White infant deaths and Black infant deaths. Thus, further study is required.

Application to Social Determinants of Health Model and Ecological Theory

The results of the study provide justification as to the need and validity of theories such as the Social Determinants of Health Model and the Ecological Theory. The Social Determinants of Health Model posits that women and their babies must be examined not only as individuals but as members of families, communities and large

systems that can have a positive or negative impact on a woman's psychological and physical state. As evidenced by the odds of infant mortality for Blacks and Hispanics, the communities that the women live in have a negative impact on the adverse birth outcomes that they experience. For women living in disadvantaged neighborhoods, race/ethnicity changes from a risk factor to a protective factor for Blacks and Hispanics with regards to infant mortality. This study examined women as individuals and members of communities in which they live. The results show the complexities of research on maternal and child health outcomes, based on factors such as neighborhood environment, marital status, race, and education level.

This study utilized an ecological model to examine the relationship of individual, and community level factors to infant mortality. The ecological framework identifies two key concepts: (1) that individual behavior affects and is affected by the social environment and (2) that behavior both shapes and is shaped by multiple levels of influence. The ecological model acknowledges that examining the ecological niche of the family, the community, and the political and social environments in which a person lives is essential in helping to understand and to prevent health problems (Alio et al., 2009). The ecological model provides a framework from which to examine racial disparities and community factors for women, as well as identify opportunities to improve women's outcomes. Finally, the ecological model provides different lenses from which to view the complex issue of infant mortality.

With regards to the current study, Washington DC is a unique blend of demographics including diverse races and ethnicities, rates of marriage, education,

and neighborhood conditions. Thus, for many residents, Washington DC is not a typical U.S. environment. DC is a majority Black city and even within the Black race there is a continuum of incomes, levels of education, and marital status. The combination of many low and middle income Blacks, middle to high income Whites, and mostly low income Hispanics creates a cultural and contextual environment where race alone does not solely influence rates of infant mortality. Consideration of the multiple components of individual, familial, and community variables is essential to understand infant mortality in the Washington DC and the United States.

Programmatic and Policy Implications

In spite of the current study's limitations, the results have implications for public health agencies, such as non-profits and health departments. From previous research we know that programs must be designed and implemented to target the unique characteristics of pregnant women. For example, Black women are most at risk for having a child that is low birth weight/ and or for not surviving to their first birthday and are more likely to be teenage mothers who are unmarried. Programming could be offered within Black communities to target those young girls and their families who are most at risk. With regards to Hispanics, although they experience the second lowest rates of infant mortality, their extremely high rates of less than high school education is associated with an increased risk for infant mortality. However, Hispanics are more likely to be married, and live in households that include a grandmother or older woman who may assist with the childrearing (MacDorman, 2008). Education may be associated with the likelihood to access more resources and needed services, and programs. Further, given the important role of family,

programs should be designed that include family members regarding behavior risks and health interventions.

Finally, the results indicate the importance of targeting neighborhood environments as part of the development of comprehensive programs in addition to addressing individual characteristics. Black and Hispanic women experienced lower rates of infant mortality despite living in a disadvantaged neighborhood, suggesting there are important but as yet unclear neighborhood strengths and protective factors derived from the Washington DC environments where they live. Building on the importance of utilizing community data for the examination of health disparities, a multi-faceted approach needs to be implemented by DC government to reduce inequities and improve its residents' physical and social environment. A collaborative effort across the health department, housing authority, public schools, and employment services would help to assure that DC residents have access to services, housing, and educational resources that will improve their quality of life and ultimately the birth outcomes of women. The measures of neighborhood disadvantage that comprised the index used in the study provide opportunities for improvement. Specifically, the percent of people unemployed, the percent of vacant housing units, and the percent of renter occupied housing are starting points for improving outcomes that influence infant mortality. Ward 3 has the highest rates of home ownership and median income and the least amount of families living below the poverty line. Places such as Ward 3, should be the gold standard for services, cleanliness, and access to resources for the entire city.

Implications for Black Women in DC

The results of the present study in particular have implications for Black women in Washington DC. Previous research in the area of neighborhoods, race/ethnicity and birth outcomes have found results similar to the present study. Pickett et.al found that maternal characteristics varied by racial density in Chicago. Mothers who were in predominately Black tracts were significantly more likely to be teenage mothers and to have had less than a high school education. Additionally, the Black women in the Pickett study were less likely to be married, and had late or no prenatal care. Women living in predominately Black neighborhoods were significantly more likely to have low birth weight and preterm birth infants. As seen in the current study, Black women were more likely to have low birth weight and preterm births, as well as infant deaths. Thus the results of both the Pickett study and the current study have implications for Black women in DC.

The results of the study speak to the need for further research in this area. Black women have the highest rates of infant mortality and adverse birth outcomes in Washington DC. Thus, organizations such as the DC Department of Health's Healthy Mom Healthy Baby program, community based organizations such as the DC Birthing Center and the DC Public Schools should work collaboratively to educate young Black women about healthy pregnancies, infant mortality, and how to access necessary care and services.

The DC Department of Health's Community Health Administration should consider implementing a system to monitor, evaluate, and respond to teenage

pregnancy and infant mortality in Washington DC. Collection and accurate tracking of cases of infant death such as the Fetal Mortality review policy recommendations and programs to reduce the rates of infant death for women of color will begin to make an impact. Finally, organizations such as Planned Parenthood and the DC Department of Health need to create an aggressive social marketing campaign to educate women of color in DC about prenatal care and other health behaviors in pregnancy. Through the use of media such as Facebook, Twitter, and radio stations, pertinent information can be disseminated to the community in a culturally competent and age appropriate manner that will reflect diversity.

Black women in DC face unique difficulties related to poverty and disadvantage. Specifically, in certain parts of the city women are not able to access proper medical care due to a lack of a full-service hospital. Thus, the lack of proper care in their proximal geographic area makes women's health and pregnancy a burdensome situation. For some Black women in DC, the only way to access proper medical care is to take one or multiple buses across town. The precursor to the doctor's visit is that women will need to take time off from work, find a babysitter or bring other children with them, and wait in crowded waiting rooms to see a physician who may or may not be culturally competent. All of these logistic challenges add to a woman's stress level during her pregnancy and undoubtedly influence her birth outcomes. Thus, this study is morally and socially relevant to the lives of Black women in DC.

Directions for Future Research

The results of this study indicate that future studies in the realm of neighborhood level influences on health need to include data on both individual people and the geographic area where they live. Also, future studies should have sufficient numbers of neighborhoods and populations to allow for comparisons of within and between neighborhood variations. Furthermore, these studies should have a wide variety of types of neighborhoods such as neighborhoods with mixed incomes and demographics in order to include rates of marriage, college education, and race/ethnicity in the analysis. A wider variety of neighborhood types would help to uncover more explicitly the factors that influence adverse birth outcomes. An additional area of research would be to identify patterns of exposure to different community conditions such as violence, crime, and trauma with regards to adverse birth outcomes such as infant mortality. The inclusion of stress in a future index of neighborhood level data would also determine if there was a relationship between this contextual factor and infant mortality.

An expansion of a variety of contextual factors such as the location of health services would elucidate additional health and behavioral factors that may influence birth outcomes. The impact of increased access to unhealthy habits would undoubtedly influence infant mortality in a way that has not been thoroughly examined to date. These results suggest that the amount of social support women receive during pregnancy, whether from partners, other family members or friends may be important for their health behaviors and birth outcomes, despite the apparent

disadvantage of the neighborhood. Future research should examine the different types of support women receive and their impact on their well-being. Finally, through the use of qualitative and quantitative research such as focus groups and long-term ethnographic observation as well as direct data collection, future studies will need to further disentangle and discuss the race/ethnic differences in infant mortality and uncover some of the individual barriers women face.

Conclusion

The major purpose of this study was to examine the influence of race/ethnicity and neighborhood disadvantage on infant mortality in Washington DC. The results indicated that both race/ethnicity and neighborhood disadvantage collectively and separately directly influence infant mortality. Overall, the study substantiated the research questions and hypotheses that were posed with regards to the main independent variables of race/ethnicity and neighborhood disadvantage The current findings underscore the importance for public health providers and policy makers to focus on all races/ethnicities and the character of the neighborhoods families live in for the reduction of infant mortality in Washington DC, in addition to focusing on the unique needs of Black mothers, who display the highest risk.

Appendix A – IRB Approval from the University of Maryland

UNIVERSITY OF MARYLAND
INSTITUTIONAL REVIEW BOARD

2100 Lee Building
College Park, Maryland 207
301.405.2412 TEL 301.314.
irb@deans.umd.edu
www.umresearch.umd.edu/I

December 09, 2009

MEMORANDUM

Application Approval Notification

To: Dr. Elaine A. Anderson
Dr. Sandra Hofferth
Ndidi N. Amutah
Family Science

From: Joseph M. Smith, MA, CIM
IRB Manager
University of Maryland, College Park

Re: **IRB Application Number:** 09-0801
Project Title: "Predictors of Infant Mortality"

Approval Date: December 09, 2009

Expiration Date: December 09, 2012

Type of Application: Initial

Type of Research: Exempt

Type of Review for Application: Exempt

The University of Maryland, College Park Institutional Review Board (IRB) approved your IRB application. The research was approved in accordance with the University IRB policies and procedures and 45 CFR 46, the Federal Policy for the Protection of Human Subjects. Please include the above-cited IRB application number in any future

Appendix B- Birth Certificate, 2003 Version

GOVERNMENT OF THE DISTRICT OF COLUMBIA
DEPARTMENT OF HEALTH
CERTIFICATE OF LIVE BIRTH

DATE REGISTERED: **CERTIFICATE/FILE NO** 108:YYYY:000000

CHIL D

1. CHILD'S NAME (First, Middle, Last, Suffix)
2. TIME OF BIRTH (24 hr)
3. SEX
4. DATE OF BIRTH (Mo/Day/Yr)
5. FACILITY NAME (If not institution, give street and number)
6. CITY, TOWN, OR LOCATION OF BIRTH (24hr)
6a. COUNTY OF BIRTH
7. PLACE WHERE BIRTH O CCURRED (Check one)
? Hospital
? Freestanding birthing center
? Home Birth: Planned to deliver at home? ? Yes ?No
? Clinic/Doctor's office
? Other (Specify)_____
8. ATTENDANT'S NAME, TITLE, AND NPI
NAME: _____ NPI:_____
TITLE: ? MD ? DO ? CNM/CM ? OTHER MIDWIFE
? OTHER (Specify)_____

CERTIFIE R

9. CERTIFIER'S NAME: _____
TITLE: ? MD ? DO ? HOSPITAL ADMIN. ? CNM/CM ? OTHER MIDWIFE
? OTHER (Specify)_____
10. DATE CERTIFIED
_____/ _____/ _____
MM DD YYYY
11. DATE FILED BY REGISTRAR
_____/ _____/ _____ __
MM DD YYYY

MOTHE R

12a. MOTHER'S CURRENT LEGAL NAME (First, Middle, Last, Suffix)
12b. DATE OF BIRTH (Mo/Day/Yr)
12c. MOTHER'S NAME PRIOR TO FIRST MARRIAGE (First, Middle, Last, Suffix)
12d. BIRTHPLACE (State, Territory, or Foreign Country)
12e. RESIDENCE OF MOTHER -STATE
12f. COUNTY
12g. CITY, TOWN, OR LOCATION
12h. STREET AND NUMBER
12i. APT. NO.
12j. ZIP CODE
12k. INSIDE CITY LIMITS?
? Yes ? No

MOTHE R

13. MOTHER'S MAILING ADDRESS: ? Same as residence, or: State: City, Town, or Location:
Street & Number: Apartment No.: Zip Code:
14. MOTHER MARRIED? (At birth, conception, or any time between) ? Yes ? No
IF NO, HAS PATERNITY ACKNOWLEDGEMENT BEEN SIGNED IN THE HOSPITAL? ? Yes ? No
15. SOCIAL SECURITY NUMBER REQUESTED FOR CHILD? ? Yes ? No
16. FACILITY ID. (NPI)
17. MOTHER'S SOCIAL SECURITY NUMBER:
18. FATHER'S SOCIAL SECURITY NUMBER:

FATHE R

19a. FATHER'S CURRENT LEGAL NAME (First, Middle, Last, Suffix)
19b. DATE OF BIRTH (Mo/Day/Yr)
19c. BIRTHPLACE (State, Territory, or Foreign Country)

INFORMAN T

20. I certify that the personal information on this certificate is correct to the best of my knowledge and belief.
Name of Informant:_____ _____
21. RELATIONSHIP TO CHILD

Hospital Copy - Not for Issuance

Confidential- for Statistical Purposes ONLY

MOTHER

22. MOTHER'S EDUCATION (Check the box that best describes the highest degree or level of school complet ed at the time of delivery)
? 8th grade or less
? 9th - 12th grade, no diploma
? High school graduate or GED completed
? Some college credit but no degree
? Associate degree (e.g., AA, AS)
? Bachelor's degree (e.g., BA, AB, BS)
? Master's degr ee (e.g., MA, MS, MEng, MEd, MSW, MBA)
? Doctorate (e.g., PhD, EdD) or Professional degree (e.g., MD, DDS, DVM, LLB, JD)

23. MOTHER OF HISPANIC ORIGIN? (Check the box that best describes whether the Mother is Spanish/Hispanic/Latina. Check the "No" box if mother is not Spanish/Hispanic/Latina)
? No, not Spanish/Hispanic/Latina
? Yes, Mexican, Mexican American, Chicano
? Yes, Puerto Rican
? Yes, Cuban
? Yes, other Spanish/His panic/Latina
Specify_____

24. MOTHER'S RACE (Check one or more races to indicate what the mother considers herself to be)
? White
? Black or African American
? American Indian or Alaska Native
(Name of the enrolled or principal tribe)_____
? Asian Indian
? Chinese
? Filipino
? Japanese
? Korean
? Vietnamese
? Other Asian (Specify)_____
? Native Hawaiian
? Guamanian or Chamorro
? Samoan
? Other Pacific Islander (Specify)_____
? Other (Specify)_____

FATHER

25. FATHER'S EDUCATION (Check the box that best describes the highest degree or level of school co mpleted at the time of delivery)
? 8th grade or less
? 9th - 12th grade, no diploma
? High school graduate or GED completed
? Some college credit but no degree
? Associate degree (e.g., AA, AS)
? Bachelor's degree (e.g., BA, AB, BS)
? Master's degree (e.g., MA, MS, MEng, MEd, MSW, MBA)
? Doctorate (e.g., PhD, EdD) or Professional degree (e.g., MD, DDS, DVM, LLB, JD)

26. FATHER OF HISPANIC ORIGIN? (Check the box t hat best describes whether the Father is Spanish/Hispanic/Latino. Check the "No" box if father is not Spanish/Hispanic/Latino)
? No, not Spanish/Hispanic/Latino
? Yes, Mexican, Mexican American, Chicano
? Yes, Puerto Rican
? Yes, Cuban
? Yes, other Spanish/Hispanic/Latino
Specify_____

27. FATHER'S RACE (Check one or more races to indicate what the father considers himself to be)
? White
? Black or African American
? American Indian or Alaska Native
(Name of the enrolled or principal tribe)_____
? Asian Indian
? Chinese
? Filipino
? Japanese
? Korean
? Vietnamese
? Other Asian (Specify)_____
? Native Hawaiian
? Guamanian or Chamorro
? Samoan
? Other Pacific Islander (Specify)_____
? Other (Specify)_____

MOTHE R

28a. DATE OF FIRST PRENATAL CARE VISIT
_____/_____/_____ ? No Prenatal Care
MM DD YYYY
28b. DATE OF LAST PRENATAL CARE VISIT
_____/_____/_____
MM DD YYYY
28c. TOTAL NUMBER OF PRENATAL VISITS FOR THIS PREGNANCY
_____ (If none, enter "0".)

29. MOTHER'S HEIGHT
_____ (feet/inches)
30. MOTHER'S PREPREGNANCY WEIGHT
_____ (pounds)
31. MOTHER'S WEIGHT AT DELIVERY
_____ (pounds)
32. DID MOTHER GET WIC FOOD FOR HERSELF DURING THIS PREGNANCY? ? Yes ? No

Not for Issuance

33. NUMBER OF PREVIOUS LIVE BIRTHS (Do not include this child)

33a. Now Living
Number ____
? None

33b. Now Dead
Number ____
? None

34. NUMBER OF OTHER PREGNANCY OUTCOMES (spontaneous or induced losses or ectopic pregnancies)

34a. Other Outcomes
Number ____
? None

35. CIGARETTE SMOKING BEFORE AND DURING PREGNANCY
For each time period, enter either the number of cigarettes or the number of packs of cigarettes smoked. IF NONE, ENTER "0". Average number of cigarettes or packs of cigarettes smoked per day.

	# of cigarettes		# of packs
Three Months Before Pregnancy	_____	OR	_____
First Three Months of Pregnancy	_____	OR	_____
Second Three Months of Pregnancy	_____	OR	_____
Third Trimester of Pregnancy	_____	OR	_____

36. PRINCIPAL SOURCE OF PAYMENT FOR THIS DELIVERY
? Private Insurance
? Medicaid
? Self-pay
? Other (Specify)
_____

33c. DATE OF LAST LIVE BIRTH
_____/_____
MM YYYY

34b. DATE OF LAST OTHER PREGNANCY OUTCOME
_____/_____
MM YYYY

37. DATE LAST NORMAL MENSES BEGAN
____/____/_____
M M D D YYYY

38. MOTHER'S MEDICAL RECORD NUMBER

39. MOTHER TRANSFERRED FOR MATERNAL MEDICAL OR FETAL INDICATIONS FOR DELIVERY? ? Yes ? No IF YES, ENTER NAME OF FACILITY MOTHER TRANSFERRED FROM: _____

MEDICAL AND HEALTH INFORMATION

40. RISK FACTORS IN THIS PREGNANCY (Check all that apply)
Diabetes
? Prepregnancy (Diagnosis prior to this pregnancy)
? Gestational (Diagnosis in this pregnancy)

Hypertension
? Prepregnancy (Chronic)
? Gestational (PIH, preeclampsia)
? Eclampsia

? Previous preterm birth

? Other previous poor pregnancy outcome (Includes perinatal death, small-for-gestational age/intrauterine growth restricted birth)

? Pregnancy resulted from infertility treatment-If yes, check all that apply:
? Fertility-enhancing drugs, Artificial Insemination or Intrauterine insemination
? Assisted reproductive technology (e.g., in vitro fertilization (IVF), gamete intra fallopian transfer (GIFT))

? Mother had a previous cesarean delivery
If yes, how many _____

? None of the above

41. OBSTETRIC PROCEDURES (Check all that apply)
? Cervical cerclage
? Tocolysis

External cephalic version:
? Successful
? Failed
? None of the above
? Other(Specify) _____

42. METHOD OF DELIVERY
A. Was delivery with forceps attempted but unsuccessful?
? Yes ? No

B. Was delivery with vacuum extraction attempted but unsuccessful?
? Yes ? No

C. Fetal presentation at birth
? Cephalic
? Breech
? Other

D. Final route and method of delivery (Check one)
? Vaginal/Spontaneous
? Vaginal/Forceps
? Vaginal/Vacuum
? Cesarean
If cesarean, was a trial of labor attempted?
? Yes
? No

43. ONSET OF LABOR (Check all that apply)
? Premature Rupture of the Membranes (prolonged ≥12 hrs.)
? Precipitous Labor (<3 hrs.)
? Prolonged Labor (≥ 20 hrs.)
? None of the above

44. INFECTIONS PRESENT AND/OR TREATED DURING THIS PREGNANCY (Check all that apply)
? Gonorrhea
? Syphilis
? Chlamydia
? Hepatitis B
? Hepatitis C
? HIV
? None of the above

45. CHARACTERISTICS OF LABOR AND DELIVERY (Check all that apply)
? Induction of labor
? Augmentation of labor
? Non-vertex presentation
? Steroids (glucocorticoids) for fetal lung maturation received by the mother prior to delivery
? Antibiotics received by the mother during labor
? Clinical chorioamnionitis diagnosed during labor or maternal temperature ≥38°C (100.4°F)
? Moderate/heavy meconium staining of the Amniotic fluid
? Fetal intolerance of labor such that one or more of the following actions was taken: in-utero resuscitative measures, further fetal assessment, or operative delivery
? Epidural or spinal anesthesia during labor
? None of the above
? Other(Specify) _____

46. MATERNAL MORBIDITY (Check all that apply)
(Complications associated with labor and delivery)
? Maternal transfusion
? Third or fourth degree perineal laceration
? Ruptured uterus
? Unplanned hysterectomy
? Admission to intensive care unit
? Unplanned operating room procedure following delivery
? None of the above

NEWBORN

47. NEWBORN MEDICAL RECORD NUMBER

48. BIRTH WEIGHT (grams preferred, specify unit)
_____
? grams ? lb/oz

49. OBSTETRIC ESTIMATE OF GESTATION:
_____ (completed weeks)

50. APGAR SCORE:
Score at 5 minutes:_____
If 5 minute score is less than 6,
Score at 10 minutes: _____

51. PLURALITY - Single, Twin, Triplet, etc.
(Specify)_____

52. IF NOT SINGLE BIRTH - Born First, Second, Third, etc
(Specify) _____

53. ABNORMAL CONDITIONS OF THE NEWBORN (Check all that apply)
? Assisted ventilation required immediately following delivery
? Assisted ventilation required for more than six hours
? NICU admission
? Newborn given surfactant replacement therapy
? Antibiotics received by the newborn for suspected neonatal sepsis
? Seizure or serious neurologic dysfunction
? Significant birth injury (skeletal fracture(s), peripheral nerve injury, and/or soft tissue/solid organ hemorrhage which requires intervention)
? None of the above
? Other(Specify) _____

54. CONGENITAL ANOMALIES OF THE NEWBORN (Check all that apply)
? Anencephaly
? Meningomyelocele/Spina bifida
? Cyanotic congenital heart disease
? Congenital diaphragmatic hernia
? Omphalocele
? Gastroschisis
? Limb reduction defect (excluding congenital amputation and dwarfing syndromes)
? Cleft Lip with or without Cleft Palate
? Cleft Palate alone
? Down Syndrome
? Karyotype confirmed
? Karyotype pending
? Suspected chromosomal disorder
? Karyotype confirmed
? Karyotype pending
? Hypospadias
? None of the anomalies listed above
? Other(Specify) _____

55. WAS INFANT TRANSFERRED WITHIN 24 HOURS OF DELIVERY? ? Yes ? No
IF YES, NAME OF FACILITY INFANT TRANSFERRED TO:_____

56. IS INFANT LIVING AT TIME OF REPORT?
? Yes ? No ? Infant transferred, status unknown
If Infant Expired, enter date of death:
____/____/____
MM DD YYYY

57. IS THE INFANT BEING BREASTFED AT DISCHARGE?
? Yes ? No

58. MOTHER REFUSED VACCINATION ? YES ? NO

59. VACCINATION GIVEN AT HOSPITAL ? YES ? NO

60. HEPB VACCINATION DATE: ____/____/____ MM DD YYYY	61. HEPB VACCINATION TIME	62. HEPB VACCINATOR	63. HEPB MANUFACTURER	64. HEPB LOT NUMBER
65. HBIG VACCINATION DATE ____/____/____ M M D D YYYY	66. HBIG VACCINATION TIME	67. HBIG VACCINATOR	68. HBIG MANUFACTURER	69. HBIG LOT NUMBER

Appendix C- Death Certificate 2005 Version

Date Filed

CERTIFICATE OF DEATH

File number 108–

To Be Completed/Verified By: Funeral Director/Medical Examiner
Initiator of record enters the data available for items 1-6

1a. DECEDENT'S LEGAL NAME (First, Middle, Last) | 1b. DECEDENT'S AKA | 2. SEX | 3. DATE PRONOUNCED DEAD | 4. TIME PRONOUNCED DEAD

5. SOCIAL SECURITY NUMBER | 6a. AGE | 6b. < 1 YR Mo. Days | 6c. < 1 DAY Hrs. Min. | 7. DATE OF BIRTH (Mo/Day/Yr) | 8. BIRTHPLACE (City and state or foreign country)

9a. RESIDENCE - STATE | 9b. COUNTY | 9c. CITY, TOWN, OR LOCATION

9d. STREET AND NUMBER AND QUADRANT | 9e. APT. NO. | 9f. ZIP CODE | 9g. INSIDE CITY LIMITS? ❑ YES ❑ NO

10. EVER IN U.S. ARMED FORCES? ❑ YES ❑ NO ❑ Unknown

11. MARITAL STATUS AT TIME OF DEATH ❑ Married ❑ Married, but separated ❑ Widowed ❑ Divorced ❑ Never Married ❑ Unknown

12. MAIDEN NAME (If decedent was married woman, enter maiden name)

13. SURVIVING SPOUSE (If wife, give name prior to first marriage)

14. FATHER'S NAME (First, Middle, Last)

15. MOTHER'S NAME PRIOR TO FIRST MARRIAGE (First, Middle, Last)

16a. INFORMANT'S NAME | 16b. RELATIONSHIP TO DECEDENT | 16c. MAILING ADDRESS (Street and Number and Quadrant, City, State, Zip Code)

17a. PLACE OF DEATH (Check only one)

IF DEATH OCCURRED IN A HOSPITAL: ❑ Inpatient ❑ ER/Outpatient ❑ DOA

IF DEATH OCCURRED SOMEWHERE OTHER THAN HOSPITAL: ❑ Hospice Facility ❑ Nursing Home/Long Term Care Facility ❑ Decedent's Home ❑ Other (Specify)

17b. FACILITY NAME (If not institution, give street and number) | 17c. CITY, TOWN, STATE WASHINGTON, D.C. | 17d. ZIP CODE

18. METHOD OF DISPOSITION ❑ Burial ❑ Donation ❑ Removal from District of Columbia ❑ Cremation ❑ Entombment ❑ Other _____

19a. PLACE OF DISPOSITION (Name of cemetery or crematory, other place) | 19b. DATE OF DISPOSITION

19c. LOCATION - CITY OR TOWN AND STATE | 20. NAME AND COMPLETE ADDRESS OF FUNERAL FACILITY

21. FUNERAL SERVICE LICENSEE (TYPE & SIGN) | 22. LICENSE NUMBER

23. DECEDENT'S EDUCATION: (Check the box that best describes the highest degree or level of school completed at the time of death)
❑ 8th grade or less (includes none)
❑ 9th - 12th grade, but no diploma
❑ High school graduate or GED completed
❑ Some college credit, but no degree
❑ Associate degree (e.g., AA, AS)
❑ Bachelor's degree (e.g., AB, BA, BS)
❑ Master's degree (e.g., MA, MBA, MEd, MS, MSW)
❑ Doctorate or professional degree (e.g., DDS, DO, DVM, EdD, JD, LLB, MD, PhD)
❑ Unknown

24. DECEDENT OF HISPANIC ORIGIN: (Check one or more boxes to best describe whether the decedent is Spanish/Hispanic/Latino. check the "No" box if decedent is not Spanish/Hispanic/Latino)
❑ No, not Spanish/Hispanic/Latino
❑ Yes, Mexican, Mexican American, Chicano
❑ Yes, Puerto Rican
❑ Yes, Cuban
❑ Yes, other Spanish/Hispanic/Latino (specify) _____
❑ Unknown

25. DECEDENT'S RACE: (Check one or more races to indicate what the decedent considered himself or herself to be)
❑ White
❑ Black or African American
❑ American Indian or Alaska Native (Name of enrolled or principal tribe) _____
❑ Asian Indian
❑ Chinese
❑ Filipino
❑ Japanese
❑ Korean
❑ Vietnamese
❑ Other Asian (specify) _____
❑ Native Hawaiian
❑ Guamanian or Chomorro
❑ Samoan
❑ Other Pacific Islander (specify) _____
❑ Other (specify) _____
❑ Unknown

26. DECEDENT'S USUAL OCCUPATION (Indicate type of work done during most of working life. Do not use retired.)

27. KIND OF BUSINESS / INDUSTRY

To Be Completed By: CERTIFIER

CAUSE OF DEATH (See instructions and example)

28. **PART I.** Enter the chain of events - diseases, injuries, or complications - that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line.

Approximate interval: Onset to death (include Min., Hr., Day, Yrs., etc.)

IMMEDIATE CAUSE (Final disease or condition resulting in death)
a. _____ DUE TO (or as a consequence of):
b. _____ DUE TO (or as a consequence of):

Sequentially list conditions, if any, leading to the cause listed on line a. Enter the **UNDERLYING CAUSE** (disease or injury that initiated the events resulting in death) **LAST**.
c. _____ DUE TO (or as a consequence of):
d. _____

PART II. Enter other significant conditions contributing to death but not resulting in the underlying cause given in Part I.

29. WAS AN AUTOPSY PERFORMED? ❑ Yes ❑ No

30. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? ❑ Yes ❑ No

31. DID TOBACCO USE CONTRIBUTE TO DEATH? ❑ Yes ❑ Probably ❑ No ❑ Unknown

32. IF FEMALE ❑ Not pregnant within past year ❑ Pregnant at time of death ❑ Not pregnant, but pregnant within 42 days of death ❑ Not pregnant, but pregnant within 43 days to 1 year before death ❑ Unknown if pregnant within past year

33. MANNER OF DEATH ❑ Natural ❑ Homicide ❑ Accident ❑ Pending Investigation ❑ Suicide ❑ Could not be determined

34. DATE OF INJURY (Mo/Day/Yr) (Spell Month) | 35. TIME OF INJURY | 36. PLACE OF INJURY (Decedent's home, construction site, restaurant, wooded area, etc.) | 37. INJURY AT WORK? ❑ Yes ❑ No ❑ Unknown

38. LOCATION OF INJURY: Street & Number: | Apartment No.:

City or Town: | State: | Zip Code:

39. DESCRIBE HOW INJURY OCCURRED

40. IF TRANSPORTATION ACCIDENT, SPECIFY: ❑ Driver/Operator ❑ Pedestrian ❑ Passenger ❑ Other (specify) _____

41. NAME OF PERSON PRONOUNCING DEATH (If other than certifier) | 42. LICENSE NUMBER | 43. DATE SIGNED (Mo/Day/Yr)

44a. WAS MEDICAL EXAMINER CONTACTED? ❑ Yes ❑ No | IF YES, TYPE NAME OF ME | 44b. DATE | 44c. ME CASE NUMBER

45a. CERTIFIER (Check only one)
❑ Certifying physician - To the best of my knowledge, death occurred at the time, date, and place, and due to the cause(s) and manner stated.
❑ Pronouncing and Certifying physician - To the best of my knowledge, death occurred at the time, date, and place, and due to the cause(s) and manner stated.
❑ Medical Examiner - On the basis of examination, and/or investigation, in my opinion, death occurred due to the cause(s) and manner stated.

Signature of Certifier: | Type Name/Title:

45b. ADDRESS OF CERTIFIER (Type or print) | 45c. LICENSE NUMBER | 45d. DATE CERTIFIED (Mo/Day/Yr)

46a. CREMATION AUTHORITY GRANTED BY (SIGNATURE & DATE) | 46b. STAMP

47. REMARKS - IF DECEDENT UNDER 4 YEARS, ENTER PLACE OF BIRTH – HOSPITAL OR ADDRESS, IF NOT IN HOSPITAL

Form DOH159 09/2005

GOVERNMENT OF THE DISTRICT OF COLUMBIA • DEPARTMENT OF HEALTH
CERTIFICATE OF DEATH

To Be Completed/Verified By: Funeral Director/Medical Examiner
Initiator of record enters the data available for Items 1-6

1a. DECEDENT'S LEGAL NAME (First, Middle, Last)	1b. DECEDENT'S AKA	2. SEX	3. DATE PRONOUNCED DEAD	4. TIME PRONOUNCED DEAD

5. SOCIAL SECURITY NUMBER	6a. AGE	6b. < 1 YR Mo.	6b. < 1 YR Days	6c. < 1 DAY Hrs.	6c. < 1 DAY Min.	7. DATE OF BIRTH (Mo/Day/Yr)	8. BIRTHPLACE (City and state or foreign country)

IMPORTANT

(1) This permit must accompany the body to the place of burial or cremation if in the District of Columbia; otherwise to the wharf, station or other place from which shipment is made.
(2) When burial has taken place within the District of Columbia it is the duty of the superintendent or other person having charge of the cemetery where the within described remains have been interred to return this permit after having signed it and entered thereon the name of the cemetery, date of burial and information as to the exact location of the grave in which said body was interred.
(3) When burial has taken place within the District of Columbia, it is the duty of the superintendent or other person having charge of the cemetery where the within described remains have been cremated to return this permit after having signed it and entered thereon the name of the crematory and date of cremation of the remains.
(4) If the remains herein described are to be cremated or otherwise destroyed, this permit does not become valid and is not a legal protection to the person cremating or destroying the same until it has been countersigned by the Medical Examiner of the District of Columbia so as to authorize each cremation or destruction.
(5) Any alteration to this permit must be made by the Department of Human Services and officially signed.

RETURN FROM PLACE OF DISPOSAL

Respectfully returned to the Vital Records Division, Department of Health, 825 North Capitol St., N.E., Washington, DC 20002, in compliance with required law.

Method of Disposal: ❑ Burial ❑ Cremation ❑ Donation ❑ Entombment ❑ Other _____

Cemetery of Crematory Authority shall fill out section below:

The deceased named above was ❑ buried ❑ cremated in the cemetery or crematory named in item 19a.

Burial was in Section _____ Lot _____ Grave _____

Signature _____

Official Title _____

Date Signed _____

18. METHOD OF DISPOSITION	19a. PLACE OF DISPOSITION (Name of cemetery or crematory, other place)	19b. DATE OF DISPOSITION
❑ Burial ❑ Donation ❑ Removal from District of Columbia ❑ Cremation ❑ Entombment ❑ Other _____		

19c. LOCATION - CITY OR TOWN AND STATE	20. NAME AND COMPLETE ADDRESS OF FUNERAL FACILITY

21. FUNERAL SERVICE LICENSEE (TYPE & SIGN)	22. LICENSE NUMBER

To Be Completed By: CERTIFIER

CAUSE OF DEATH (See instructions and example)

28. **PART I.** Enter the chain of events - diseases, injuries, or complications - that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line.

		Approximate interval: Onset to death (include Min., Hr., Day, Yrs., etc.)
IMMEDIATE CAUSE (Final disease or condition resulting in death)	a. _____ DUE TO (or as a consequence of):	
Sequentially list conditions, if any, leading to the cause listed on line a. Enter the **UNDERLYING CAUSE** (disease or injury that initiated the events resulting in death) **LAST**.	b. _____ DUE TO (or as a consequence of):	
	c. _____ DUE TO (or as a consequence of):	
	d. _____	

PART II. Enter other significant conditions contributing to death but not resulting in the underlying cause given in Part I.	29. WAS AN AUTOPSY PERFORMED? ❑ Yes ❑ No
	30. WERE AUTOPSY FINDINGS AVAILABLE TO COMPLETE THE CAUSE OF DEATH? ❑ Yes ❑ No

31. DID TOBACCO USE CONTRIBUTE TO DEATH?	32. IF FEMALE	33. MANNER OF DEATH
❑ Yes ❑ Probably ❑ No ❑ Unknown	❑ Not pregnant within past year ❑ Pregnant at time of death ❑ Not pregnant, but pregnant within 42 days of death ❑ Not pregnant, but pregnant within 43 days to 1 year before death ❑ Unknown if pregnant within past year	❑ Natural ❑ Homicide ❑ Accident ❑ Pending investigation ❑ Suicide ❑ Could not be determined

34. DATE OF INJURY (Mo/Day/Yr) (Spell Month)	35. TIME OF INJURY	36. PLACE OF INJURY (Decedent's home, construction site, restaurant, wooded area, etc.)	37. INJURY AT WORK?
			❑ Yes ❑ No ❑ Unknown

38. LOCATION OF INJURY: Street & Number:	Apartment No.:

City or Town:	State:	Zip Code:

39. DESCRIBE HOW INJURY OCCURRED	40. IF TRANSPORTATION ACCIDENT, SPECIFY: ❑ Driver/Operator ❑ Pedestrian ❑ Passenger ❑ Other (specify) _____

41. NAME OF PERSON PRONOUNCING DEATH (If other than certifier)	42. LICENSE NUMBER	43. DATE SIGNED (Mo/Day/Yr)

44a. WAS MEDICAL EXAMINER CONTACTED? ❑ Yes ❑ No	IF YES, TYPE NAME OF ME	44b. DATE	44c. ME CASE NUMBER

45a. CERTIFIER (Check only one)
❑ Certifying physician - To the best of my knowledge, death occurred at the time, date, and place, and due to the cause(s) and manner stated.
❑ Pronouncing and Certifying physician - To the best of my knowledge, death occurred at the time, date, and place, and due to the cause(s) and manner stated.
❑ Medical Examiner - On the basis of examination, and/or investigation, in my opinion, death occurred due to the cause(s) and manner stated.

Signature of Certifier: Type Name/Title:

45b. ADDRESS OF CERTIFIER (Type or print)	45c. LICENSE NUMBER	45d. DATE CERTIFIED (Mo/Day/Yr)

46a. CREMATION AUTHORITY GRANTED BY (SIGNATURE & DATE)	46b. STAMP

47. REMARKS - IF DECEDENT UNDER 4 YEARS, ENTER PLACE OF BIRTH – HOSPITAL OR ADDRESS, IF NOT IN HOSPITAL

Form DOH159 09/2005

Appendix D- Definition of Variables

Multi-variate regression models will be run using the following independent variables:

- race of mother
  - Black
  - Hispanic
  - White
  - Other
- age of mother at birth
  - <20 years old
  - 20-24
  - 25-29
  - 30-34
  - 35 and older
- characteristics of the Ward in which the mother lives (Neighborhood disadvantage index)
  - Percent Black
  - Percent unemployed
  - Percent married
  - Percent of renter occupied housing
  - Percent of vacant housing units
  - Median household income
  - Percent of families living in poverty
  - Percent of females who are head of household
  - Percent of people with a high school or less than high school degree
- Adequacy of prenatal care index (Kessner)
  - Number of prenatal visits
  - When prenatal care began
  - Gestational age
  - Birth weight
- mother's marital status
  - Married
  - Single
- mother's education
  - Less than high school
  - High school
  - Some college
  - College degree
- birth weight of infant (dichotomized)
  - low birth weight (under 2500 grams)
  - very low birth weight (under 1500 grams)
  - normal birth weight
- preterm birth (dichotomized)
  - preterm birth (birth before 35 weeks of gestation)
  - no preterm birth (births after 35 weeks of gestation)

Appendix E- Factor Analysis for Disadvantage Score by Ward

Ward	Factor Score	Frequency	Percent
3	-2.00281439	6475	11.58
4	-0.70367229	8066	14.42
2	-0.59705406	5391	9.64
6	0.01895338	6336	11.33
1	0.215697814	8058	14.41
5	0.31104977	6022	10.77
7	0.751912441	6730	12.03
8	1.145289867	8860	15.84

Appendix E cont.-Factor Score-Recoded for Disadvantage

Factor Score Recoded	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Not Disadvantaged	19932	35.63	19932	35.63
Disadvantaged	36006	64.37	55938	100

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