

DISPARITIES IN BIRTH WEIGHT BETWEEN NON-HISPANIC BLACKS AND  
NON-HISPANIC WHITES: THE EFFECT OF RURAL RESIDENCY

by

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## ABSTRACT

Disparities in Birth Weight Between Non-Hispanic Blacks and Non-Hispanic Whites:

The Effect of Rural Residency

by

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The purpose of this study is to assess the prevalence of low birth weight among non-Hispanic Blacks and non-Hispanic Whites along the rural/urban continuum, as well as the combined effect of being both non-Hispanic Black and residing in a completely rural county. Degree of social isolation and lack of support are proposed mechanisms for explaining disparities in low birth weight for Blacks in rural counties.

Using data from the National Longitudinal Survey of Youth 1979 (NLSY79) and the National Longitudinal Survey of Youth 1979 Child (NLSY79-C) datasets, logistic regression models were used to estimate the odds of low birth weight. Key variables employed in these models include race/ethnicity, a five category measure of counties by degree of rural versus urban residence, interaction terms for race by county categorization, measures of the degree of community level support or isolation,

household composition as a measure of the family support structure, access to medical care, maternal SES, birth characteristics, and maternal pregnancy behavior.

Results demonstrate that Blacks have much higher odds of low birth weight than Whites and living in a completely rural county exacerbates disadvantage in birth weight outcomes for non-Hispanic Blacks but not for non-Hispanic Whites. The community and household level support measures have little mediating effect on the magnitude of the negative birth weight outcomes found for non-Hispanic Blacks in the most rural counties. However, the first order effect for non-Hispanic Blacks was almost completely explained by the presence of the father in the household when interaction effects for race and place of residence were also included in the model.

(77 pages)

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## LIST OF ABBREVIATIONS

-2LL	-2 Log Likelihood
$\beta$	Beta Coefficient
FIPS	Federal Information Processing Standards
LBW	Low Birth Weight
MA	Metropolitan Area
NLSY79	National Longitudinal Survey of Youth, 1979
NLSY79-C	National Longitudinal Survey of Youth, 1979 Child Survey
OMB	Office of Management and Budget
S.E.	Standard Error
SES	Socioeconomic Status
UA	Urbanized Area

# CHAPTER 1

## INTRODUCTION

Infant health is important for many reasons. On a societal level, infant mortality and health are considered proxy indicators of the state of a society's public health system because infants and children see the greatest benefits in health when social or medical improvements are made in the initial stages of a society's economic development (Caldwell 1986; Gortmaker and Wise 1997). In more developed countries such as the United States, infant health is important because the prevalence of poor birth outcomes is so unequally distributed between different races, classes and geographic areas. These disparities in infant health reflect systematic inequality and the unaddressed needs of society. Furthermore, on an individual level, infant health is important because the repercussions of health as infants (whether positive or negative) have been shown to have lifelong consequences, affecting susceptibility or resistance to many health conditions in adulthood (Elo and Preston 1992; Hayward and Gorman 2004; Rich-Edwards et al. 2005).

This research seeks to compare infant health differences between the most rural counties as compared to more urban counties for non-Hispanic Blacks and non-Hispanic Whites<sup>1</sup>, as well as the specific effect on infant health of being Black in a rural county. Whites tend to have better overall health than Blacks (McCord and Freeman 1990; Williams and Collins 1995). This is true for all ages, but in reference to infant health specifically, there are greater chances of low birth weight, small for gestational age births and higher rates of infant mortality for Blacks than for Whites (Alexander et al. 1999;

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<sup>1</sup> From henceforth, non-Hispanic Blacks will be referred to interchangeably as non-Hispanic Blacks, Blacks or African Americans, and non-Hispanic Whites as non-Hispanic Whites or Whites.

Collins et al. 1998; Frisbie, Forbes, and Pullum 1996; Grady 2006; Hummer et al. 1999; National Center for Health Statistics 2007; Reichman et al. 2008). Rates of low birth weight, infant mortality and small for gestational age births are approximately twice as high for Blacks than for Whites (National Center for Health Statistics 2007; Elo et al. 2009; Reichman et al. 2008).

The social sources of African American disadvantage in infant health are based on an accumulation of several forms of social isolation that reduce the support available to pregnant women and mothers. This support can take many forms, such as knowledge about healthy pregnancy behavior that may be shared with peers or handed down from older generations. Support can also be purely financial, especially at the household level, making single mothers especially susceptible to poverty and to having less healthy infants (Reichman et al. 2008). Essentially, the strength of a mother's social environment, or the number of people around a mother willing to help and support her during pregnancy, affects the health of her infant. Black women are more likely to be single mothers, which isolates and is detrimental to the amount of support available during pregnancy (England and Edin 2007). At the community level, Blacks who are poor are more often concentrated in racially and economically isolated neighborhoods (Massey and Fischer 2000; Williams and Collins 1995; Wilson 1996). The racial and economic isolation more often faced by Black mothers has been found to negatively affect infant health by undermining available support (Collins and Butler 1997; Collins et al. 1998; Grady 2006; Grady and Ramirez 2008; Howell 2008). It seems that social isolation is still divided along the color line, just as it has been for the entirety of American history. This

connection with the past is no coincidence, but rather the actual source of the collection of racially dividing elements which seep so far into the fabric of our lives that infant health is changed by it. Race and class isolation are explored in more detail in this thesis as mechanisms for explaining disparities in infant health.

The extent of racial disparities in infant health in rural areas as compared to urban areas has not been given much attention in the past. Much of the previous research on racial and ethnic disparities in infant mortality and birth weight has focused on the needs of the urban poor because this is the group that is most often identified as experiencing the worst infant health status within the United States (Auger et al. 2008; Collins et al. 1998; Grady 2006; Grady and Ramirez 2008; Hearst, Oakes, and Johnson 2008; Howell 2008; Inagami et al. 2006; Kramer and Hogue 2008). However, when considering health differences by place on a continuum of rural and urban classifications, rather than as a dichotomous distinction, more rural areas have also been shown to have poorer health profiles and therefore are still an important segment of the population to consider in health policy development (Auchincloss and Hadden 2002; Clarke and Coward 1991; Hillemeier et al. 2007; Hughes and Rosenbaum 1989; Ormond, Zuckerman, and Lhila 2000). Adjacency to urban environments makes a difference in place variation of health patterns. Rural counties which are not adjacent to an urban county have poor health profiles (Clarke and Coward 1991; Hillemeier et al. 2007; Hughes and Rosenbaum 1989; Ormond et al. 2000). That is, the *most* rural areas have as much of a need for health care improvements as inner city areas. The reason for worse health outcomes of infants in rural areas is also related to isolation, both economic and spatial. The sparse population

of rural counties reduces the support networks of mothers. Large scale economic restructuring of rural America has caused economic challenges for residents as the numbers and types of jobs have shifted over the past few decades (Brown and Kandel 2006; Johnson and Cromartie 2006; Kirschner, Berry, and Glasgow 2006). Limitations in access to care for rural areas have also been postulated as a source of health disparity (Hughes and Rosenbaum 1989; Miller et al. 1996; Mueller, Patil, and Boilesen 1998; Probst et al. 2007). The role of these factors as mechanisms in creating rural infant health disparities are examined in this thesis.

The focus of this thesis is to compare infant health between Whites and Blacks while also exploring how living in a rural county affects infant health for Blacks differently than for Whites. The interaction of being Black and living in more rural areas along the rural-urban continuum has not been thoroughly examined in previous literature and is expected to exacerbate negative infant health outcomes. Lack of social support through several types of social isolation is proposed as the explanation for the probable worse infant health outcomes for Blacks in rural areas.

The National Longitudinal Survey of Youth 1979 (NLSY79) and the National Longitudinal Survey of Youth 1979 Child survey data (NLSY79-C) will be used in this study (U.S. Department of Labor 2008). The NLSY79-C data uniquely identifies all births of women in the original NLSY79 dataset. There are a total of 5,196 White and Black infants being considered in this analysis, with 459 of these infants being low birth weight (below 2500 grams at the time of birth). The dependent variable is low birth weight and the main independent variables include: (1) a five category county of

residence typology code, based on the Economic Research Service (ERS) rural-urban continuum codes or Beale codes, (2) racial or ethnic classification as either White or Black and (3) interaction terms for race and ethnicity with the five category county of residence codes. Variables that measure the mother's degree of social isolation and lack of support at the household and community level are included in later models as they are expected to mediate the effect of race and place on the prevalence of low birth weight. Percent distribution of low birth weight between Whites and Blacks along the rural-urban continuum are assessed descriptively in the analysis and a series of logistic regression models are also created to estimate the odds of low birth weight along the rural-urban continuum for Blacks and Whites, and also to explain the mechanisms responsible for differences in odds of low birth weight.

This thesis will add to previous literature by examining the interaction of rural and urban residence with race and ethnicity on the odds of low birth weight, with special emphasis on the mediating effect of social support. Birth weight is used as a proxy for infant health because it is a very good predictor of overall infant health and infant mortality (National Center for Health Statistics 2007). Greater knowledge of infant health differences in rural versus urban areas, as well as clarification of how these differences vary between and within racial and ethnic groups, has the potential to better inform location specific health policies.

The following chapters will discuss previous work and the theoretical basis for this research, give a more detailed description of the methodology used in this thesis,

report the results of this study and end with a discussion of conclusions that may be drawn from this work.

## CHAPTER 2

### LITERATURE REVIEW

#### **The Importance of Infant Health**

Infants and children are the most vulnerable to economic and social forces that influence health negatively. For this reason, the health of infants and children has historically been considered a proxy indicator for the overall health of a society in the early stages of economic development or industrialization (Caldwell 1986; Frisbie 2006; Gortmaker and Wise 1997). Due to great improvements in public health and medicine over the past century, infant mortality rates have dropped precipitously in developed countries such as the United States (Singh and Yu 1995).

In light of such tremendous improvements in infant health and survival, the importance of infant health as an indicator of societal level well-being may seem less salient in modern industrial societies such as the United States. However, disparities in infant health between groups illuminate persistent disadvantage and inequality in health that are important to recognize in determining the future direction of public health policy (Singh and Yu 1995). The source of inequality in infant health for Blacks relative to Whites is complex, involving an historical legacy of racial discrimination that resulted from an accumulation of economic and social disadvantages that have become entrenched in every stage of life for Blacks in the United States. Astonishingly, scientific evidence tells us that differences between health for Blacks and Whites begin before a child is even born (National Center for Health Statistics 2007; The United Nations



Children's Fund and World Health Organization 2004), making birth outcomes and infant health one of the first access points for the creation of inequality and disadvantage that will last a lifetime, as well as one of the earliest points in time when efforts can be made to reduce this inequality. Exploring the economic and social sources of Black disadvantage informs ways to narrow the gap in infant health and squelch this aspect of the legacy of discrimination and disadvantage faced by African Americans.

Health disadvantage that begins in infancy affects health throughout the life course. Many studies show that low birth weight or poor health during childhood can negatively affect an individual's chances of developing a myriad of health problems later in life and increase the risk of mortality (Elo and Preston 1992). This begins in the first year of life, with low birth weight being one of the leading causes of infant mortality (National Center for Health Statistics 2008). One specific example of how this increased risk extends through adulthood is a study that shows an increased risk of coronary heart disease and stroke in women of low birth weight (Rich-Edwards et al. 2005). The far reaching effect of early life health has also been demonstrated in historical analysis of societal level improvements in public health. Historically, life expectancy has improved with each subsequent cohort as societal level improvements in public health are made, meaning that children who had benefits such as clean water beginning early in life, had better health in adulthood than their parents who did not have these benefits during childhood (Preston and Van de Walle 1978). Clearly, infant health can greatly influence adult health and longevity.

The health of a mother and her infant are dependent on many aspects of the woman's life, but the direct social influences on maternal and child health can be loosely categorized as stemming from a few key concepts: (1) pregnancy and child care knowledge, (2) behavior or a lack of positive behavioral influences, (3) social isolation or a lack of childcare and pregnancy support and (4) economic disadvantage or a lack of financial support (Colen et al. 2006; Haas et al. 2004; Miller et al. 1996; Schempf et al. 2007; Zhang and Harville 1998). These four concepts are determined by economic, family and community structures that are greatly influenced by race/ethnicity and place of residence. The reasons that race/ethnicity and place of residence influence economic, community and family structure, and in turn, the social determinants of infant health are discussed below, with a specific focus on the disadvantage facing Blacks and the rural population. A brief discussion of the definition of rural and urban residency, as well as a discussion of access to care in rural areas, is also included in this section.

### **Family Structure and Social Isolation at the Household Level**

The socially oriented roots of disadvantage faced by Blacks are linked to changes in normative behavior associated with family formation in the United States. In 1950 34% of women 15 years of age and older in the United States were not married, but by 2008 this increased to 47% of women 15 years of age and older. This trend toward fewer marriages is even more apparent for Black women, 66% of whom were not married in 2008 as compared to 38% in 1950 (U.S. Census Bureau 2008). Not only are Black women today less likely than White women or the previous generation of Black women

to marry, but Black women with less education and lower income are even less likely to be married (Bennett, Bloom, and Craig 1989; England and Edin 2007). Over the past few decades it has also become more prevalent and more socially acceptable to have a child outside of marriage (Bumpass 1990; Thornton and Young-DeMarco 2001). Single motherhood also occurs more often for women of lower education levels, lower incomes and for African American mothers (England and Edin 2007). The increase in single mother households undermines the level of family support available to mothers, which has a negative effect on infant health (Campos et al. 2008; Colen et al. 2006; Hogan, Hao, and Parish 1990; Kana'Iaupuni et al. 2005; Sherraden and Barrera 1997).

This is not to say that the traditional nuclear family is the only effective support structure for women and their children. Studies have shown that the presence of any other adult in the household during pregnancy and childbearing greatly increases the support received by the mother. This increased family support is positively associated with higher infant birth weight and general infant and child health (Campos et al. 2008; Kana'Iaupuni et al. 2005; Sherraden and Barrera 1997). In black families specifically, the presence of the grandmother in the household has been shown to improve infant and child health and well-being (Colen et al. 2006). Furthermore, the use of extensive kin networks for financial and childcare support is much more likely for single Black mothers than for single White mothers (Hogan et al. 1990). However, absent fathers are still more likely for Black mothers than for White mothers (England and Edin 2007). This means that the overall level of family support may still leave Black mothers at a disadvantage.

Changes in family structure have resulted in fewer married mothers and often lead to less family support during pregnancy and in raising children. Black mothers are especially disadvantaged in this regard, unless a grandmother or other supportive adult is present in the household to help temper the negative effect of single motherhood on infant health. The type of support provided by another adult in the household takes many forms, but those relevant to infant health include the four concepts discussed previously: sharing of pregnancy and child care knowledge, positive behavioral influences, pregnancy and childcare support and financial support.

Single motherhood is especially prevalent in impoverished and socially isolated Black communities (England and Edin 2007). Rural areas also often have higher levels of poverty, as well as poor health outcomes which are often associated with poverty (Auchincloss and Hadden 2002; Farmer, Clarke, and Miller 1993; Ormond et al. 2000). As will be discussed in more detail below, rural areas are also more socially isolating, especially for Black women of childbearing age. When these facts are taken together, it is not surprising that this thesis expects to find a higher prevalence of low birth weight for Blacks in rural counties. The worse birth outcomes for Blacks in rural counties are expected to be partially explained by differences in marital status, household structure and the knowledge and behavior differences that are facilitated by a supportive household environment.

## **Rural Economic Structure and Social Isolation at the Community Level**

In rural areas, isolation and poverty have been exacerbated by the changing economy of rural America across the second half of the twentieth century. The changes have resulted in increases in low paying, service based employment for those who are less educated in rural areas (Brown and Kandel 2006; Johnson and Cromartie 2006; Kirschner et al. 2006). The economies of rural areas have historically been dependent on industries such as farming, ranching, mining and manufacturing, but this is no longer true in the present day. Farm restructuring in the early and mid twentieth century increased the efficiency of farm practices and led to a high number of commercial farms that do not require as many employees. Mining and manufacturing industries are also declining as natural resources are depleted and as manufacturing has increasingly been moved to cheaper production operations in other countries. The result has been a larger exodus of young adults than any other age group from rural areas as they begin to enter the workforce and seek employment (Johnson and Cromartie 2006). A potential implication of this rural exodus on mothers who remain in rural areas is smaller peer groups. The exodus of youth is thought to have negative implications for the types of social support, knowledge sharing and positive behavioral influences available to pregnant women. The percentage of females between the ages of 20-54 years of age in rural areas is smaller than in urban areas, but this is especially true for Black females, who make up one third or less of the Black population in nonmetro areas in all regions of the country except for

the south (Kirschner et al. 2006). The tendency for many young adults to move out of rural areas leaves a much smaller and socially isolated group behind.

The impact of the significant loss in farming, mining and manufacturing jobs in the rural economy has been mediated in some cases by increases in other industries. In rural areas, economic growth has primarily occurred due to increases in service sector employment and in amenity rich areas of the country (Gibbs, Kusmin, and Cromartie 2005; Jensen, Goetz, and Swaminathan 2006; Johnson and Cromartie 2006). Service sector employment is a broad category that refers to jobs in education and health care, customer service, call centers, casino and gaming employment and many other forms of employment that are not based on goods production (Gibbs et al. 2005; Jensen et al. 2006; Johnson and Cromartie 2006). The shift to service sector employment can also be thought of in terms of low-skill service jobs versus high-skill service jobs. Growth in high-skill service jobs is seen as a benefit because these jobs typically provide better pay, but they also require more education and training (Gibbs et al. 2005), meaning that the dissemination of jobs in the changing rural economy is not equal. The number of low-skilled service jobs has decreased overall in rural areas, leading to fewer job opportunities for those of lower education and skill levels (Gibbs et al. 2005). Unfortunately, it does not follow that people are necessarily able to gain the education needed to fill these better positions. More often, this process has resulted in a greater social divide between the rich and the poor and the types of jobs available to them (Wilson 1996). This undoubtedly increases the level of class isolation in rural areas, meaning that there is much less

positive influence and support across class lines, leaving the most impoverished groups to fend for themselves with the most limited financial resources.

A lower concentration of low-skilled employment in goods production (farming and manufacturing) and a higher concentration in low-skilled service production has a negative effect on rural places because the low-skilled service industry generally pays much less, and is less likely to be unionized than the low-skilled goods industries of the past (Kirschner et al. 2006; Wilson 1996). The replacement of jobs in farming, mining and manufacturing to service sector employment is also of interest here because farming, mining and manufacturing employ a larger number of males, while service occupations greatly favor females (Kirschner et al. 2006; Wilson 1996). This may exacerbate problems associated with household and family structure discussed above in the context of changing norms of family formation. Overall, the combined effect of the type of jobs available in rural areas, the level of qualification required in these jobs and the changes in pay for jobs of lower skill levels results in the poor becoming more impoverished due to the replacement of low-skilled farming and manufacturing jobs with a fewer number of low skilled service sector jobs.

Rural areas often have higher levels of poverty which are associated with worse health outcomes (Auchincloss and Hadden 2002; Farmer et al. 1993; Ormond et al. 2000). Poverty and low education levels are known predictors for much of the disparity in infant health specifically. Women who live in poverty or who have lower levels of education are more likely to have low birth weight infants (Clarke and Coward 1991; Hillemeier et al. 2007; National Center for Health Statistics 2007, 2008). Infant health is

expected to be worse for Blacks in rural counties because the social isolation and high poverty rates in rural areas have a negative effect on pregnancy knowledge sharing, positive behavioral influences, pregnancy support and financial resources.

### **Non-Hispanic Black Economic Disadvantage and Residential Segregation**

In the United States, infant health status is not equal between all racial and ethnic groups. White infants are healthier and are more likely to survive infancy than most minority groups. In 2005, 7.29% of White births were low birth weight (less than 2,500 grams) as compared to 14.02% of Black births that were low birth weight (National Center for Health Statistics 2008). For Blacks, the percent of low birth weight infants is almost twice that of the White population. In addition to the infant health disadvantages faced by rural Blacks based on family structure and the rural economy, racial discrimination and social isolation can also affect the quality of knowledge networks, social support on the community level and individual socioeconomic status.

This thesis expects to find a higher prevalence of low birth weight infants as the mother's county of residence becomes more rural. A higher prevalence of low birth weight infants is also expected among Blacks and especially among Blacks in more rural counties. As mentioned before, the source of disadvantage for Blacks in rural areas is rooted in the economic and social forces that affect family and community structures. The social forces that lead to disadvantaged family structure and the economic forces in rural areas that affect community structure have already been discussed. However, there



are also economic and social forces related to disadvantage that result from racial discrimination against African Americans (Mason et al. 2009; Williams and Collins 1995). Economic disadvantage and spatial isolation are linked to race/ethnicity for Blacks and have led to concentrated poverty and racial isolation for many Black communities (Massey and Fischer 2000; Wilson 1996). Lower community socioeconomic status has been associated with concentrated poverty and high racial isolation. In turn, concentrated poverty and racial isolation have been found to affect infant health negatively (Collins and Butler 1997; Collins et al. 1998; Grady 2006; Grady and Ramirez 2008; Howell 2008). This leads to the conclusion that the racial context of a place may be just as important as the socioeconomic context of a place in determining the types of support or the degree of isolation present in the community.

African Americans have often been spatially separated from the White majority. Spatial separation and isolation is pervasive and persistent, often leaving African Americans in impoverished neighborhoods and situations that are difficult to get out of due to the lack of opportunity that this isolation breeds (Massey and Fischer 2000; Wilson 1996). Evidence of the negative impact of this physical separation is found in many forms. William Julius Wilson's (1996) descriptions of impoverished, African American urban ghettos highlight how isolation and poverty is reproduced and expanded. Due to economic restructuring in the United States, these impoverished Black neighborhoods have been left without enough jobs and without the means of improvement (Wilson 1996). Obviously, economic negligence has occurred on a societal

level due to the dominant pattern of turning a blind eye upon this persistently separated population.

There are also environmental factors that can negatively affect health. As an example, the aftermath of Hurricane Katrina's destruction highlights how spatial separation leads to African American disadvantage in the quality of the surrounding environment. The negative repercussions of Katrina were far greater for African Americans in New Orleans because the poor Black neighborhoods in the city were found on land at lower sea levels, while the White neighborhoods were at higher elevations and were less vulnerable to flooding and the resulting destruction, pollution and loss of life (McKittrick and Woods 2007). Racially and economically segregated neighborhoods are not only placed in less desirable locations, but also are more likely to have dangerous or toxic facilities move into the area. As an example, a recent study found a higher proportion of superfund sites located in poor African American neighborhoods (Smith 2009). All of these examples not only show how the physical place that a person lives in is influenced by race and class position, but also how this distribution leads to less opportunity, undesirable living conditions and even unsafe living conditions for Blacks through the racial residential segregation that persists in the United States.

In general, fewer economic opportunities, fewer public resources and negative environmental factors are often more concentrated in neighborhoods with higher percentages of Black (Massey and Fischer 2000; Williams and Collins 1995; Wilson 1996). The racial composition of the mother's county of residence is therefore included in this study and is expected to explain some of the disparity between infant birth weight

for Whites and Blacks. The strength of the effect of county level percent Black is unclear in rural environments because lower population densities may negate the specific effect of racial isolation as it is usually thought of in an urban context. However, due to the association that racial isolation has with areas of concentrated poverty, the measurement of county racial composition in this analysis of racial and ethnic health differences is considered necessary and potentially informative.

### **Infant Health Variation and the Definition of Rural and Urban Residency**

It is important to briefly discuss the differences in the way that rural and urban have been defined in past studies in order to justify the appropriateness of the measure chosen in this study. Differences in health based on rural or urban residency vary greatly depending on what type of health is being measured as well as the definition of rural and urban being used. If using a simple dichotomous measure of metropolitan versus non-metropolitan area then rural areas usually give the impression of having better health outcomes than their urban counterparts (Farmer et al. 1993; Rock and Straub 1994). This outcome sometimes holds true when a third category is created by adding a distinction for adjacency to metro areas (Larson, Hart, and Rosenblatt 1992). Furthermore, when rural and urban areas are broken into more distinct categories that account for differences in population size as well as adjacency to urban counties, the smallest rural populations that are also non-adjacent to urban centers clearly have health outcomes that are as bad as or worse than those in the most urban areas (Auchincloss and Hadden 2002; Clarke and

Coward 1991; Farmer et al. 1993; Ormond et al. 2000). Also, suburban areas for both races have been shown to have the best health outcomes in some studies, which has clearly played a role in obscuring differences in simple categorizations of rural and urban (Farmer et al. 1993; Hillemeier et al. 2007).

When disaggregating rural and urban differences by race, further differences surface. In a descriptive study, Blacks in the most rural areas (based on population size alone) were found to have lower rates of infant mortality than Blacks in urban areas, but Whites in the most rural areas have higher rates of infant mortality than Whites in urban areas (Farmer et al. 1993). Because Farmer et al.'s (1993) results are in opposition to patterns of infant health based on degree of rurality alone, their research illuminates the need for multivariate analysis to assess how race and rural/urban residency relate to infant health and work together to affect infant health. This thesis hopes to expand on this specific point by examining the interaction effects of race and rural/urban residence on infant birth weight.

### **Access to Care in Rural Areas**

The concepts utilized herein to explain disparities in infant birth weight by race and place are social isolation and concentrated poverty as facilitators of lower levels of support, knowledge exchange and positive behavioral influences. However, one cannot discuss rural health disparities without examining the effect of access to care. Many studies have asserted that access to care in rural areas is limited because of longer distances to health care facilities, fewer available medical personnel, fewer hospitals per

person and lower proportions of individuals with health insurance (Hughes and Rosenbaum 1989; Miller et al. 1996; Mueller et al. 1998; Probst et al. 2007). Infant health differences are often measured through the differential use of prenatal care between urban versus rural counties (Hughes and Rosenbaum 1989; Miller et al. 1996). Mueller et al. (1998) determined that health insurance is the best determinant of health care utilization for all race/ethnicities and for both rural and urban residents. The use of prenatal care and health insurance status are both included in this analysis in order to control for differences in access to care that may exist based on individual level characteristics. The number of doctors per person in the mother's county of residence is also included as a control of access to care differences that may exist on the county level.

### **Research Hypotheses**

The focus of this study is to examine the differences in patterns of infant birth weight between Whites and Blacks along a rural/urban continuum. Birth weight differences based on race/ethnicity and place are expected to be mediated by family and household structure, as well as the economic and social characteristics of the county of residence that define the degree of racial, class and spatial isolation. The following hypotheses will be tested:

- 1 The odds of low birth weight will be higher in the most rural areas as compared to the most urban areas.
- 2 Non-Hispanic Blacks in rural areas will have higher odds of low birth weight than non-Hispanic Blacks in urban areas.

- 3 Non-Hispanic Blacks in rural areas will have higher odds of low birth weight than non-Hispanic Whites in rural areas.
- 4 Low Birth Weight disparities between non-Hispanics White and non-Hispanic Blacks will be wider in completely rural areas than in the most urban areas.
- 5 Low Birth Weight disparities between non-Hispanics White and non-Hispanic Blacks will be partially explained by economic, community and family structures.

### **Summary**

Economic, family and community structures that map the environment a woman lives in, the knowledge available to her, behavioral patterns of her social group and the financial resources at her disposal can affect infant health. The combined effect of economic, family and community structures has the most negative impact among Blacks and in the most rural counties through the mechanisms of race, class and spatial isolation. Isolated communities create limitations in resources such as information exchange, behavioral influences and social and financial support for pregnant women. By measuring aspects of household structure, family and community poverty and other family and community resources, this thesis hopes to illuminate the mechanisms responsible for the worse birth outcomes that are expected for Blacks, the most rural counties and the interaction of the two.

Actual pregnancy knowledge and behavior of the mother is measured in this study, reflecting the influence of knowledge networks and behavioral influences on infant health. Knowledge and behavior are thought to be negatively affected by social

isolation. However, a weakness of this study is that social support and the actual influences and knowledge gained through a mother's support network cannot be directly measured, but are instead measured through their social determinants as reflected in economic, family and community structures. Specifically, household structure will be measured to estimate how the presence of other adults in the household mediates the higher prevalence of low birth weight that is expected for Blacks in rural counties. Maternal poverty status in the year of birth and other maternal SES variables will also be included to examine how much of the difference in low birth weight prevalence for Blacks and rural counties can be explained through individual and household level measures of financial security and support. I will also measure the effect of class isolation or concentrated poverty by examining the percentage of people in poverty in the county. I also include the percent Black female in the county to determine whether racial isolation plays a role in low birth weight prevalence through smaller social networks that may exist for Black females in rural areas. I include county population density as well, to examine the degree that low spatial population density in very rural areas, and the resulting spatial isolation, contributes to limited knowledge exchange and support. Lastly, I include the number of doctors per capita as a county characteristic affecting access to health care resources that may be limited in more rural areas.

In the next chapter detailed information about the data being used in this analysis, the measurement of the variables used to operationalize the concepts discussed above, and the organization of the analysis will be given. Subsequent chapters will discuss the results of the analysis and the conclusions that can be drawn from this work.

## CHAPTER 3

### METHODOLOGY

#### **Data**

This thesis uses two datasets developed by the U.S. Department of Labor (2008). The National Longitudinal Survey of Youth 1979 (NLSY79) provides the detailed maternal information used in this study. The National Longitudinal Survey of Youth 1979 Child (NLSY79-C) and Young Adult data provides detailed information about the children of the NLSY79 females. These children constitute the units of analysis in this study. All maternal data taken from NLSY79 are matched to each of her individual children in the NLSY79-C data through the mother's identification code.

The NLSY79 is a panel study that began in 1979 with 12,686 total respondents. Respondents were interviewed annually from 1979 to 1994 and then every other year from 1994 to 2006 for a total of 22 waves. In the 2006 survey year there were 7,654 respondents still being interviewed of the original 12,686 respondents. The difference in the number of respondents between 1979 and 2006 is partially due to funding constraints which resulted in dropping 1,079 respondents from the military oversample and 1,643 respondents from the Hispanic, Black and economically disadvantaged, non-Black/non-Hispanic oversample. The remaining difference of 2,310 respondents between 1979 and 2006 comprise people who left the survey voluntarily, resulting in an 23.18% attrition rate  $[2310/(12,686 - 1079 - 1643)]$ . In the 2006 survey, 3,916 of the 7,654 respondents surveyed were women, 3,184 of whom are non-Hispanic White or Black women who



gave birth to at least one child by the 2006 survey. Births that occurred to a total of 2,214 of these women are included in this analysis after the deletion of cases that occurred before 1978, or that are missing data on the key variables for birth weight or county of residence. Another 138 cases are excluded because of missing data for either a birth characteristic, maternal characteristic or a county level variable. Beginning in 1982, retrospective fertility information was collected from all mothers in NLSY79 and in 1983 an even more detailed fertility section was included. This detailed fertility information from 1983 and subsequent survey years comprises the bulk of the fertility information used in this thesis but is taken directly from the NLSY79-C, which linked copies of this fertility data for each child. The NLSY79-C is also a panel study designed to gain information about the children of the NLSY79 female respondents. The NLSY79-C began in 1986 and was repeated every other year from that point forward in order to collect detailed information about the development of the children of the NLSY79 female respondents. In this study, the NLSY79-C is used predominately as a template because the data are organized with the children as the cases, and we are interested in an outcome variable (low birth weight) for the children. Data are also linkable to maternal information that is found exclusively in the NLSY79 data. There are 11,469 total children in the NLSY79-C dataset as of the 2006 survey year, 5,177 of which are non-Hispanic White and non-Hispanic Black children that are included in this analysis.

All non-Hispanic White and non-Hispanic Black births recorded between 1978 and 2005 are included in the analysis (no births were recorded for 2006 at the time of the 2006 survey). The 532 births before 1978 are excluded from the analysis because of the

lack of maternal data to births before the first survey wave in 1979. Births in 1978 are included using maternal data from the 1979 survey year. The use of maternal data from the following survey year is also used after the 1994 survey year because the NLSY79 reduced interviews to every other year. Due to the wide range of birth years from 1978 to 2005, a period of observation variable was included in the initial analyses. The period of observation variable is essentially the year of birth and is meant to assess whether or not births from earlier years are more likely to be low birth weight than births in the later years. However, the period of observation was found to have very little effect on the odds of low birth weight, with odds ratios ranging from 0.975 to 1.005 that were not statistically significant.

Several strengths exist in the use of the NLSY79 and the NLSY79-C data. First, the NLSY79 datasets oversample Hispanics, non-Hispanic Blacks and economically disadvantaged non-Black/non-Hispanics (referred to as non-Hispanic Whites or Whites), making this data especially useful for racial and ethnic comparisons. Second, the availability of geographical information for the county of residence in each survey year enables place comparisons. Third, the level of fertility information and prenatal maternal behavior enables the control and measurement of a number of important characteristics associated with birth weight.

Several weaknesses also exist in the use of the NLSY79 and the NLSY79-C data. First, there is no sub county geographical information. Previous research has shown that even though a county level place comparison can reveal important patterns and differences, a smaller unit of analysis for place can often tell us even more of the story

(Cromartie and Swanson 1996). Second, because these longitudinal data are used as cross-sectional data, and birth data are collected from 1978 to 2006, there could potentially be changes across time in how non-Hispanic Blacks and non-Hispanic Whites fare along the rural-urban continuum. However, period of observation did not have a significant effect on the prevalence of low birth weight, implying that changes across time may not be a significant source of variation in birth weight in this sample. Third, the exclusion of births that occurred before 1978 leaves out many births that occurred to the NLSY female respondents at younger ages, potentially limiting the conclusions that can be made based on maternal age. Fourth, though Hispanics are oversampled, there are still too few cases of low birth weight Hispanics in rural areas to allow racial/ethnic comparisons that include Hispanics in the analysis.

## **Measures**

### **Dependent Variable**

The dependent variable used in this analysis is a dichotomous variable for low birth weight (LBW) found in the NLSY79-C dataset. LBW is defined as less than 2,500 grams, or approximately 5.5 pounds at birth. Outliers were removed for birth weight less than 300 grams or more than 8,000 grams ( $N = 4$ ). The 793 cases that are missing birth weight data are excluded from the analysis. Birth weight below 2,500 grams is the standard cutoff point that indicates increased risk for negative health outcomes and infant mortality (Stevens 2002; The United Nations Children's Fund and World Health

Organization 2004). The dependent variable and all independent variables are summarized in table 3.1.

### **Main Independent Variables**

The race variable is taken from the NLSY79 maternal sample identification code which identifies respondents as non-Hispanic White, non-Hispanic Black, Hispanic or other, as well as identifying the subsample that the respondent belongs to as either the representative cross-sectional sample, the oversample of Hispanics, Blacks and economically disadvantaged Whites, or the military oversample. Respondents in the Hispanic or other group were excluded from the analysis. A set of dummy variables were then created to define each mother as either non-Hispanic White or non-Hispanic Black. Mother's race/ethnicity was used instead of child's race because much of the analysis focuses on characteristics of the mother before and during pregnancy that are presumed to affect infant birth weight. For this reason, the race/ethnicity of the mother is more relevant in assessing the source of differences in low birth weight prevalence between Blacks and Whites.

Residence was constructed using the Federal Information Processing Standard (FIPS) codes for the mother, attained with special permission from the Department of Labor in a confidential geo-code file of the NLSY79. The FIPS codes identify the county of residence for respondents during each year of the survey. The 889 cases that are missing FIPS code data are excluded from the analysis. The county that the mother lived in during the year of birth is assigned a category based on the Economic Research Service's (ERS) rural-urban continuum codes (table 3.2). These codes are updated every

**Table 3.1. Summary of Variables**

<b>Dependent Variable</b>	<b>Categories</b>
Low Birth Weight	low birth weight or normal birth weight
<b>Main Independent Variables</b>	
Race/ethnicity	non-Hispanic white or non-Hispanic black
Beale Categorization	(A) large metro, (B) small metro, (C) nonmetro, adjacent to metro, (D) nonmetro, nonadjacent, with total urban place population over 2,500 people or (E) nonmetro, nonadjacent, with total urban place population of less than 2,500 people
Interaction Effects for Race X Beale	(1) non-Hispanic Black X large metro, (2) non-Hispanic Black X small metro, (3) non-Hispanic Black X nonmetro, adjacent to metro, (4) non-Hispanic Black X nonmetro, nonadjacent, with over 2,500 urban or (5) non-Hispanic Black X nonmetro, nonadjacent, with under 2,500 urban
<b>Family/Household Composition</b>	
Mother's marital status	(1) married, (2) not married or (3) divorced, separated or widowed
Spouse or Partner of Mother	present in household or not present in household
Mother/Step/Grandmother of Mother	present in household or not present in household
<b>Community Isolation</b>	
County Percent Unemployed	continuous from 1.6% to 23.7%
County Percent Black	continuous from 0% to 75.3%
County Population Density	continuous – persons per square mile from 0.3 to 64,922.1
<b>Access to Care</b>	
Health Insurance	(1) has health insurance, (2) does not have health insurance or (3) missing health insurance data
Trimester of first prenatal care visit	(1) first trimester, (2) second trimester or (3) third trimester
Physicians in County	continuous – per 100 persons
<b>Maternal SES</b>	
Mother's Education	(1) less than high school, (2) high school, (3) associates or bachelors, (4) post graduate or (5) missing education data
Mother's Employment Status	(1) employed, (2) unemployed or (3) out of the work force
Poverty Status	(1) in poverty, (2) not in poverty or (3) missing poverty data
<b>Birth Characteristics and Maternal Behavior</b>	
Mother's age at birth	(1) teen mother of 19 years or younger, (2) average age mother of 20 to 34 years or (3) older mother of 35 or more years
Plurality	singleton birth or not singleton birth
Child's sex	male or female
Parity, child's birth order	(1) first birth, (2) second or third birth or (3) fourth or higher birth
Gestational age in weeks	short gestational age of less than 37 weeks or normal gestational age of 37 weeks or greater
Vitamins taken during pregnancy	(1) took prenatal vitamins, (2) did not take prenatal vitamins or (3) missing vitamin use data
Alcohol use during pregnancy	(1) never, (2) one to four days a month, (3) one to four days a week or (4) daily or nearly every day
Smoke cigarettes during pregnancy	(1) never, (2) less than one pack a day or (3) one or more packs a day

**Table 3.2. County Beale Code  
Assignments to NLSY Birth Years**

<b>Birth Year</b>	<b>1983 Beale</b>	<b>1993 Beale</b>	<b>2003 Beale</b>
1978	X		
1979	X		
1980	X		
1981	X		
1982	X		
1983	X		
1984	X		
1985	X		
1986	X		
1987	X		
1988	X		
1989		X	
1990		X	
1991		X	
1992		X	
1993		X	
1994		X	
1995		X	
1996		X	
1997		X	
1998		X	
1999			X
2000			X
2001			X
2002			X
2003			X
2004			X
2005			X

(Department of Labor 2008; Economic Research Service 2004)

10 years to reflect population changes based on new census data. The version of the Beale codes used is the one closest to the year of birth as summarized in table 3.2. Because the Beale codes are only updated every 10 years, a reliability check was performed to ensure that random error was not an issue in the assigning of Beale codes to such a wide range of birth years. Logistic regression outputs were compared for clusters of birth years around each census year that the Beale codes are based on (births in 1979-1981, 1989-1991 and 1999-2001) and compared to the output that includes all birth years. The reliability check showed no substantive differences between the birth year clusters and the complete analysis.

The rural-urban continuum codes define how rural or urban the county of residence is during the year of birth. The rural-urban continuum codes, also known as Beale codes, define counties in one of ten metropolitan (metro) or nonmetropolitan (nonmetro) categories that were created in 1983 and 1993, based on decennial census data. A similar set of codes was also created in 2003 based on the 2000 census, but with only nine categories (table 3.3). The largest metro definition of 2003 was divided into central and fringe metro counties in the 1983 and 1993 versions of the Beale codes, thus creating the additional category in these earlier years. This distinction was deemed unnecessary by the Office of Management and Budget (OMB) in the creation of the 2003 Beale code categories. The 1983 and 1993 split was collapsed for consistency with the 2003 Beale codes for the purpose of this study. This leaves a total of three metro categories and six nonmetro categories that are utilized in this thesis (Economic Research Service 2004).

**Table 3.3. Original Beale Code Categorization and Collapsed Categorization**

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**1983 and 1993 Rural-Urban Continuum Codes**Code    Description

## Metro counties:

- 0 Central counties of metro areas of 1 million population or more.
- 1 Fringe counties of metro areas of 1 million population or more.
- 2 Counties in metro areas of 250,000 to 1 million population.
- 3 Counties in metro areas of fewer than 250,000 population.

## Nonmetro counties:

- 4 Urban population of 20,000 or more, adjacent to a metro area.
  - 5 Urban population of 20,000 or more, not adjacent to a metro area.
  - 6 Urban population of 2,500 to 19,999, adjacent to a metro area.
  - 7 Urban population of 2,500 to 19,999, not adjacent to a metro area.
  - 8 Completely rural or less than 2,500 urban population, adjacent to a metro area.
  - 9 Completely rural or less than 2,500 urban population, not adjacent to a metro area.
- 

**2003 Rural-Urban Continuum Codes**Code    Description

## Metro counties:

- 1 Counties in metro areas of 1 million population or more
- 2 Counties in metro areas of 250,000 to 1 million population
- 3 Counties in metro areas of fewer than 250,000 population

## Nonmetro counties:

- 4 Urban population of 20,000 or more, adjacent to a metro area
  - 5 Urban population of 20,000 or more, not adjacent to a metro area
  - 6 Urban population of 2,500 to 19,999, adjacent to a metro area
  - 7 Urban population of 2,500 to 19,999, not adjacent to a metro area
  - 8 Completely rural or less than 2,500 urban population, adjacent to a metro area
  - 9 Completely rural or less than 2,500 urban population, not adjacent to a metro area
- 

**Collapsed County Categorization Used In Current Study**Code    Description

## Metro counties:

- A:0+1 Counties in large central and fringe metro areas of 1 million population or more
- B:2+3 Counties in metro areas of fewer than 1 million population

## Nonmetro counties:

- C:4+6 Total urban place population of 2,500 or more, adjacent to a metro area
  - D:5+7 Total urban place population of 2,500 or more, not adjacent to a metro area
  - E:8+9 Completely rural or less than 2,500 total urban place population
- 

(Auchincloss and Hadden 2002; Cromartie and Swanson 1996; Economic Research Service 2004)



The Beale codes were created based on population size, degree of urbanization and adjacency to metropolitan counties. In order to understand these distinctions, it is necessary to clarify how they relate to U.S. Census definitions of an urbanized area, an urban place, a metropolitan area, and the adjacency and population requirements that define the differences between the non-metropolitan categories. A metro county in the Beale code categorization is defined as a metropolitan area or MA (Economic Research Service 2004), which is a core area and its suburbs that meet requirements based on population density, percentage of population that is in an urbanized area, the percent growth and the total population (U.S. Census Bureau 2005). An urbanized area or UA is specifically in a metro area, is incorporated, has a total population of at least 50,000 people and a population density of at least 1,000 people per square mile (U.S. Census Bureau 2005).

Nonmetro counties in the Beale code categorization are defined as nonmetro areas, distinguished from each other by adjacency to a metro area and total *urban place* population, which is distinct from an urbanized area discussed above (Economic Research Service 2004). A nonmetro county is considered adjacent to a metro county if it shares a physical boundary with a metro county and at least 2% of its labor force commutes to a central metro county. What is referred to as a “total urban place population” in this study is a place specifically in a nonmetro area or outside of a UA, and is defined as a total population of at least 2,500 people in all urban places within the nonmetro area. Stated differently, adding up all of the people in all of the towns in a rural county gives us a total urban place population in that rural county. If the cumulative

population for all towns in the county is less than 2,500 people, then that county meets population criteria for being considered completely rural. However, deciding what is a “town” or urban place, has changed in the creation of the 2003 Beale codes. In 1983 and 1993, an urban place was defined as an incorporated area. An urban place in 2003 is based on population density per square mile (U.S. Census Bureau 2005). The change in Beale code categorization that is reflected in the change of definition of urban places within a nonmetro area is a limitation of the current study. The ERS calls this change conceptually comparable, but not fully comparable (Economic Research Service 2004). However, using the 1983, 1993 and 2003 Beale codes is still the best option for defining the differing place characteristics for the respondents in this study. Use of Beale codes based on later or early decades is not as likely to create the clarity of distinction that the current categorization scheme does, especially considering the high degree of urbanization and the large population shifts that have occurred over the past 3 decades in the United States.

Beale categories have been further collapsed into a 5 category distinction (table 3.3) for the purposes of this study as follows: (A) large central metro or fringe metro counties, (B) small metro counties, (C) nonmetro, adjacent to metro, (D) nonmetro, nonadjacent, with total urban place population over 2,500 people and (E) nonmetro, nonadjacent, with total urban place population of less than 2,500 people. A similar categorization scheme has been used in previous studies to collapse urban influence codes which are a similar ERS categorization scheme. This is done in order to have enough cases in all categories to produce estimates, while preserving the integrity and

validity of the original categorization scheme (Auchincloss and Hadden 2002; Cromartie and Swanson 1996).

Interaction terms were created to determine differences in low birth weight prevalence between non-Hispanic Blacks and non-Hispanic Whites along the rural-urban continuum. Interaction terms were created for non-Hispanic Blacks who live in a small metro county, non-Hispanic Blacks who live in a nonmetro county that is adjacent to a metro county, non-Hispanic Blacks who live in a nonmetro county that is not adjacent to a metro county and has a total urban place population over 2,500 people and non-Hispanic Blacks who live in a nonmetro county that is not adjacent to a metro county and has a total urban place population under 2,500 people. Interactions between Blacks and large metro counties, as well as all place interactions for Whites, were excluded as the reference category of Non-Hispanic Whites and large metro counties.

### **Individual Level Variables**

The following variables are related to each individual birth, have been shown in previous research to be important predictors of infant health (Frisbie 2006; National Center for Health Statistics 2007) and are available directly through the NLSY79-C database for each birth. The variables are summarized in table 3.1. Mothers are asked in which month of pregnancy the first prenatal care visit occurred. Prenatal care is often considered inadequate when it does not begin in the first trimester (Colen et al. 2006). Month of first prenatal care visit is recoded into three groups based on whether the first prenatal care visit was in the first trimester, second trimester or third trimester. Those who had no prenatal care or whose first visit to a physician was after the birth are

included in the highest risk category for first prenatal care which is during the third trimester. The child's birth order, or parity has been categorized for this analysis as either a (1) first birth, (2) second or third birth or (3) fourth birth or higher, referred to here as a higher order birth. Infant mortality and poor infant health are more often associated with first births (National Center for Health Statistics 2007). The child's sex is included as a dichotomous variable. Male infants generally have a higher risk of worse health and higher mortality, which are more likely with low birth weight infants (National Center for Health Statistics 2007). A categorical variable for gestational age was created for this analysis according to whether the infant has either a short gestational age of less than 37 weeks or a normal gestational age of 37 or more weeks. Short gestational age often accompanies low birth weight and is also used as a predictor of infant health and survival (National Center for Health Statistics 2007). Plurality, or a measure of whether or not the birth was a singleton birth, twin birth or a triplet birth, was reduced to a dummy variable for singleton birth or not singleton birth. The infant mortality rate and chance of low birth weight are higher for both twin and triplet births (National Center for Health Statistics 2007).

A variable for whether or not the mother took vitamins during pregnancy is also included in the analysis. Vitamin use is assumed to lower chances of a low birth weight infant because it improves the health of the mother during pregnancy. Vitamin use has a high number of missing answers due to mothers who were dropped from the survey before detailed fertility information began to be collected in 1983. A category was added

for missing data in order to ensure that there are no systematic differences in the respondents who were not asked detailed fertility questions.

Alcohol use during pregnancy is a categorical variable with the following categories: (1) never drank during pregnancy, (2) drank one to four days a month during pregnancy, (3) drank one to four days a week during pregnancy or (4) drank daily or nearly every day during pregnancy. Cigarette smoking during pregnancy is a categorical variable with the following categories: (1) did not smoke during pregnancy, (2) smoked less than one pack a day during pregnancy or (3) smoked one or more packs a day during pregnancy. Both alcohol use and cigarette smoking during pregnancy increase the risk for poor health and low birth weight infants (Frisbie 2006; National Center for Health Statistics 2007). Correlations were examined to ensure that alcohol use and cigarette smoking are not highly correlated. The correlations in this analysis range from 0.108 to 0.030 which are low enough to include both alcohol use and cigarette smoking during pregnancy separately in the analysis.

The following individual level variables have been collected annually for the mothers in NLSY79 and were matched to the NLSY79-C data where a single variable for each during the year of birth was created. The mother's age at birth has been categorized as either (1) a teen mother who is 19 years old or younger, (2) an average aged mother between 20 and 34 years old or (3) an older mother who is 35 years old or older. Teen mothers and older mothers both have increased risk for negative birth outcomes such as low birth weight (Frisbie 2006; National Center for Health Statistics 2007). The mother's marital status has been condensed into three categories for (1) married or remarried, (2)

never married and (3) divorced, separated or widowed. Unmarried mothers have been shown to have a higher risk of negative birth outcomes, presumably because of a lower level of social and financial support (National Center for Health Statistics 2007). A dummy variable for health insurance coverage was created from two different questions. From 1979 until 1988 the only health insurance question was asked of working respondents. Working respondents were asked whether health insurance benefits were provided through their most recent job. In 1989, 1990, and 1992-2006 all respondents were asked if they are covered by a health insurance plan. This variable is therefore limited and has a higher percentage of missing values for births in earlier years of the survey. For this reason, an additional category was created for missing insurance data to ensure that there is not a systematic difference in the respondents who did not report having insurance coverage through their jobs for the 1979 to 1988 survey years.

The individual level SES variables used in this analysis include maternal poverty status, education and employment status. The NLSY79 created a dummy variable for the poverty status of the respondent in each year of the survey. An additional category for missing data was also included for poverty status in this analysis because of a high number of missing cases due to non-response on income questions. Employment status of mothers was attained through a created variable in NLSY79. This variable was categorized as either (1) employed or in active forces, (2) unemployed, or (3) out of the labor force. However, this variable was not created in the 2000, 2002 or 2004 survey year so another question was used to obtain employment status information for births in these years. This alternate question is limited in that it does not distinguish between

unemployed and out of the labor force. For births in 2000, 2002 and 2004, employment status of the mother is defined as either employed or unemployed. This is considered a limitation of the study because new mothers are often not working but also not seeking work, technically placing them in the “out of the labor force” category.

The education variable used in this analysis measures the mother’s educational attainment as either (1) less than a high school education, (2) a high school degree, (3) an associates or bachelors degree, (4) a post graduate degree (masters, doctorate or professional degree), or (5) missing education information. These categories were created using several questions from NLSY79. From 1979 until 2006 respondents were asked if they have received a high school diploma or equivalent since the last survey year. This variable was used to determine which respondents had less than a high school education for each year of the survey. From 1980 until 1984 respondents were asked if they received any degree since the last interview and what type of degree was received. This information was added to high school education information to determine the highest degree received for the 1979 to 1984 survey years. From 1988 until 2006, respondents were asked information about the highest degree they ever received. This information was used in conjunction with the high school education information to create the variable for highest educational attainment. The 1985, 1986 and 1987 surveys did not gather information about the highest degree received so educational data based on the previous years was used to create an estimate of highest educational attainment for those survey years. It is also important to note that it was necessary to combine associate and

bachelor degrees into one category because a distinction was not made between these two types of degrees in the degree attainment question from the 1980 to 1984 surveys.

Household composition is assessed by the inclusion of two dichotomous variables. One indicates whether or not the mother's mother, stepmother or grandmother is present in the household. The other dichotomous variable indicates whether the mother's partner or spouse is present in the household. The presence of either of these individuals in the household is thought to reduce the chances of a low birth weight infant by increasing family support during pregnancy.

### **County Characteristics**

The NLSY79 has linked county characteristics to the individual respondent's county FIPS code from the U.S. Census Bureau's County and City Data Books for the year closest to each particular survey year. The continuous percent unemployed during the year of birth is included in this analysis as an indicator of community level socioeconomic status. Percent black in the county of birth is included as an indicator of racial isolation. Population density in the county of birth is included as an indicator of social isolation. The number of physicians per 100,000 people in the county is included as an indication of county level influence on access to care. All of these county characteristics are summarized in table 3.1.

### **Analysis**

A cross tabulation of low birth weight by race and ethnicity and by county categorization is created to assess percentage differences in low birth weight for Blacks



and Whites along the rural urban continuum. Pearson chi-square tests are then performed to determine the statistical significance of low birth weight differences between Blacks and Whites in each of the five county categorizations. A series of logistic regression models are created using maximum likelihood estimation to assess the significance and direction of the effects of race and ethnicity, place of residence and the interaction of the two on the logged odds of low birth weight. Model 1 analyzes the effects of the main independent variables for race and residence. Model 2 builds upon this by adding interaction effects for race and residence to assess differences in residential patterns of birth weight by race. Model 3 adds household composition variables and Model 4 includes measures of community isolation. Model 5 adds access to care measures, maternal SES, birth characteristics and maternal behavior during pregnancy.

Because the NLSY79-C is a complex longitudinal survey, the NLSY79-C provides a custom weights generator (U.S. Department of Labor 2008). These weights adjust for the complex survey design and for the use of data from multiple survey years. For the descriptive analysis in this thesis, the custom weights were converted to probability weights so that population parameters could be accurately estimated without bias. However, after weighting the descriptive portion of the analysis, a comparison was made between the weighted and unweighted outputs and no substantial difference in the probabilities was observed. For this reason, the custom weights were not deemed necessary in the regression analysis. It was actually preferable not to use sample weights in the regression analysis for several reasons. Not using the sample weights in the regression analysis is preferred because only a subsample of the children of the original

multi-stage stratified random sample of NLSY79 respondents is being analyzed. Infants born to NLSY79 females from 1978 forward, and for only non-Hispanic Blacks and non-Hispanic Whites are being included in the current analysis. It is possible that the weighted mean that would be generated using the custom weights when this exclusion exists may not represent the entire population of non-Hispanic Blacks and non-Hispanic Whites. The similarity in the probabilities generated in the weighted and the unweighted descriptive portion of the analysis is fortunate and negates the necessity to address more complex weighting schemes whose accuracy has been debated in statistical literature.

In summary, percentage low birth weight by race and county categorization are reported and logistic regression will be used in the multivariate analysis to estimate the odds of low birth weight by race, county categorization and the interaction of race by county categorization. Other independent variables include household composition, maternal characteristics, maternal behavior, individual level SES and county characteristics. The following chapters outline the results of the analysis and discuss the conclusions and implications of this research.

## CHAPTER 4

### RESULTS

#### **Descriptive Results**

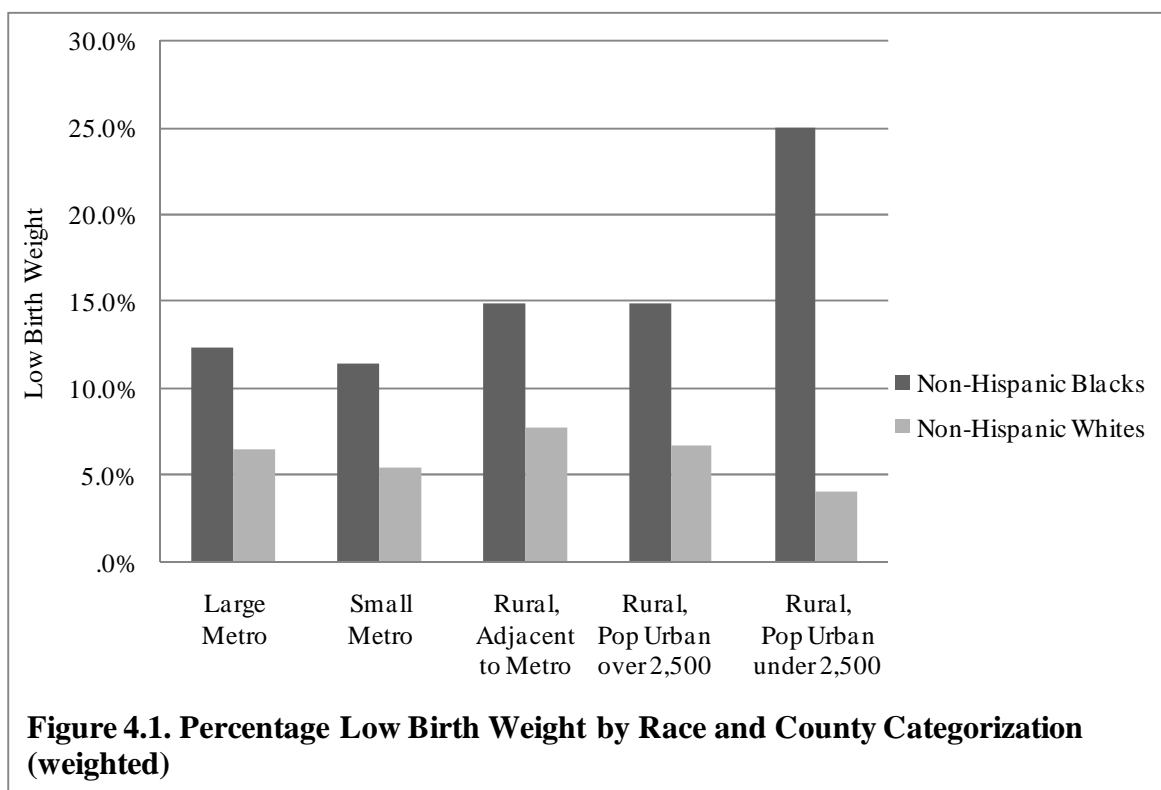
According to the weighted sample of NLSY79-C, Blacks and Whites have very different prevalence of low birth weight. The overall prevalence of low birth weight is 6.4% for Whites and 12.8% for Blacks. This means that for births to the NLSY79 mothers between 1978 and 2005, Blacks are twice as likely to be low birth weight as compared to Whites.

The distribution of low birth weight between the five categories of rural and urban residency is also very different for Blacks and for Whites (figure 4.1). The residence of the mother does not matter as much for the birth weight outcomes of Whites. There is no pattern of disparities in low birth weight for Whites between rural and urban categories. Prevalence of low birth weight wavers between 4.1% and 7.7%, with the lowest percentage of low birth weight in the most rural county category. This is very different from the clear pattern of low birth weight prevalence for Blacks, which is the lowest in the urban areas and highest in the most rural locales. The lowest prevalence of low birth weight for Blacks is 11.4% in the small metro county category. The highest prevalence of low birth weight for Blacks is 25.0% in the most rural county category. This supports the second hypothesis and indicates a much higher prevalence of low birth weight for Blacks in rural areas than in urban areas.

Comparing the prevalence of low birth weight for Blacks and Whites in each rural and urban category reveals that birth weight disparities are much wider in the most rural areas than in any other place category (figure 4.1). In large metro, small metro, adjacent to metro and larger non-adjacent counties the Black rate of low birth weight ranges from 1.92 to 2.22 times the rate for Whites. In the most rural, non-adjacent counties the Black rate of low birth weight is 6.10 times the rate of Whites. This supports the third and fourth hypotheses and indicates a much wider disparity in birth weight outcomes between Whites and Blacks in rural areas than in urban areas. The significance of this disparity is examined by performing chi-square tests for each of the five county categories (table 4.1). The prevalence of low birth weight is significantly different for Blacks and Whites for all county categories (although nonmetro counties that are adjacent to metro counties only reach marginal statistical significance).

### **Logistic Regression Results**

Multivariate analyses are conducted using maximum likelihood estimation of logistic regression models in order to compare low birth weight differences between Whites and Blacks and between rural and urban counties. Five models are created to explore which factors account for the disparities between groups. Table 4.2 presents the logit or beta coefficients ( $\beta$ ) and standard errors (S.E.) for each independent variable in the multivariate analyses. The logit shows the amount of change that occurs in the predicted logged odds of low birth weight for each unit of change in the independent variable when the independent variable is continuous. The coefficients show an increase



**Table 4.1. Pearson Chi-Square ( $\chi^2$ ) Test of Significant Racial Differences in Low Birth Weight (LBW) for Each County Categorization**

County Category:	White LBW	Black LBW	$\chi^2$	df	N
Large Metro	6.4%	12.3%	19.5 <sup>***</sup>	1	2417
Small Metro	5.4%	11.4%	14.8 <sup>***</sup>	1	1780
Nonmetro, Adjacent to Metro	7.7%	14.8%	3.2 <sup>†</sup>	1	497
Nonmetro, Nonadjacent to Metro, Urban Population of 2,500 or more	6.7%	14.9%	5.3 <sup>*</sup>	1	469
Nonmetro, Nonadjacent to Metro, Urban Population of less than 2,500	4.1%	25.0%	11.2 <sup>***</sup>	1	122

†  $p < .10$ ; \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

Table 4.2. Logistic Regression Models for Low Birth Weight

	Model 1		Model 2		Model 3		Model 4		Model 5	
	$\beta$	S.E.	$\beta$	S.E.	$\beta$	S.E.	$\beta$	S.E.	$\beta$	S.E.
<b>Main Independent Variables:</b>										
Race/Ethnicity ( <i>Non-Hispanic White</i> )										
Non-Hispanic Black	0.777**	0.099	0.588***	0.150	0.172	0.167	0.055	0.178	0.056	0.214
Beale Collapsed Categories ( <i>Large Metro Area</i> )										
Small Metro Area	-0.115	0.117	-0.252	0.174	-0.251	0.174	-0.245	0.177	-0.341†	0.203
Rural, Adjacent to Metro Area	0.266	0.170	0.149	0.225	0.127	0.226	0.172	0.233	-0.094	0.282
Rural, Non-Adjacent to Metro Area	0.197	0.165	0.037	0.243	0.010	0.243	0.030	0.251	-0.348	0.311
Completely Rural	0.454*	0.225	-0.317	0.433	-0.377	0.435	-0.344	0.438	-0.829	0.532
Interaction Terms for Race and Beale Categories										
( <i>Non-Hispanic White X Large Metro Area</i> )										
Black X Small Metro Area			0.248	0.236	0.264	0.237	0.261	0.240	0.458†	0.278
Black X Rural, Adjacent to Metro Area			0.217	0.343	0.204	0.345	0.059	0.354	0.574	0.416
Black X Rural, Non-Adjacent to Metro Area			0.292	0.332	0.323	0.334	0.251	0.339	0.495	0.431
Black X Completely Rural			1.233*	0.514	1.216*	0.517	1.040*	0.524	1.510*	0.627
<b>Family/Household Composition:</b>										
Father or Mother's Partner ( <i>Not Present</i> )										
Present in Household					-0.566**	0.205	-0.557**	0.206	-0.544*	0.232
Grandmother or Great Grandmother ( <i>Not Present</i> )										
Present in Household					-0.035	0.135	-0.048	0.135	0.000	0.171
Marital Status ( <i>Married</i> )										
Never Married					0.229	0.203	0.247	0.205	0.015	0.241
Divorced, Separated or Widowed					0.172	0.235	0.169	0.236	-0.232	0.279
<b>Community Isolation:</b>										
County Unemployment Rate ( <i>continuous</i> )							0.000	0.017	0.016	0.021
County Percent Black ( <i>continuous</i> )							-0.009*	0.004	-0.012**	0.005
County Population Density ( <i>continuous</i> )							0.000	0.000	0.000	0.000
Sample Size ( <i>n</i> )	5,196		5,196		5,196		5,196		5,196	
df	5		9		13		16		43	
-2 Log Likelihood	3033.70		3026.74		2987.96		2982.38		2182.84	

Note: referent categories for indicator variables in italicized text

† p < .10; \* p < .05; \*\* p < .01; \*\*\* p < .001

Table 4.2. (Continued).

	Model 1		Model 2		Model 3		Model 4		Model 5	
	$\beta$	S.E.	$\beta$	S.E.	$\beta$	S.E.	$\beta$	S.E.	$\beta$	S.E.
<b>Access to Care:</b>										
Prenatal Care ( <i>Began During First Trimester</i> )										
Second Trimester	0.131	0.161								
Third Trimester	0.197	0.252								
Health Insurance ( <i>Yes</i> )										
Not Insured	0.350†	0.189								
Missing Data	0.079	0.186								
Physician Rate per 100 residents ( <i>continuous</i> )	1.151†	0.595								
<b>Maternal SES Variables:</b>										
Educational Status ( <i>High School</i> )										
Less Than High School	-0.290†	0.176								
College (Associates or Bachelors)	-0.353†	0.192								
Post Graduate (Graduate or Professional)	-0.684	0.509								
Missing Data	-0.650*	0.255								
Income ( <i>Above Poverty Threshold</i> )										
Below Poverty Threshold	0.341*	0.164								
Missing Data	-0.262	0.199								
Occupational Status ( <i>Employed</i> )										
Unemployed	0.192	0.224								
Not in Labor Force	0.050	0.152								
Sample Size ( <i>n</i> )	5,196		5,196		5,196		5,196		5,196	
df	5		9		13		16		43	
-2 Log Likelihood	3033.70		3026.74		2987.96		2982.38		2182.84	

Note: referent categories for indicator variables in italicized text

† p < .10; \* p < .05; \*\* p < .01; \*\*\* p < .001

**Table 4.2. (Continued).**

	Model 1		Model 2		Model 3		Model 4		Model 5	
	$\beta$	S.E.	$\beta$	S.E.	$\beta$	S.E.	$\beta$	S.E.	$\beta$	S.E.
<b>Birth Characteristics &amp; Maternal Behavior:</b>										
Age of Mother at Birth ( <i>20 to 35 years old</i> )										
Teen Mom (under 20 years old)									-0.280	0.205
Older Mom (over 35 years old)									0.418	0.269
Single or Multiple Birth ( <i>Singleton Birth</i> )									2.867***	0.268
Twin or Triplet Birth									0.368**	0.117
Child's Sex ( <i>Female</i> )									0.099	0.134
Male									-0.132	0.216
Parity/Child's Birth Order ( <i>2nd or 3rd Birth</i> )									2.773***	0.122
First Birth									0.035	0.263
Higher Order Birth (4th or higher)									0.177	0.238
Gestational Age ( <i>Normal Age or greater than 37 Weeks</i> )									-0.012	0.141
Short Gestational Age or less than 37 Weeks									0.243	0.251
Vitamins Taken During Pregnancy ( <i>Yes</i> )									0.309	0.623
No Vitamins									0.390**	0.145
Missing Data									0.931***	0.195
Alcohol Use During Pregnancy ( <i>No Alcohol</i> )										
One to Four Days a Month										
One to Four Days a Week										
Daily or Nearly Every Day										
Cigarette Smoking During Pregnancy ( <i>Non Smoker</i> )										
Less Than One Pack a Day										
One or More Packs a Day										
Sample Size ( <i>n</i> )	5,196		5,196		5,196		5,196		5,196	
df	5		9		13		16		43	
-2 Log Likelihood	3033.70		3026.74		2987.96		2982.38		2182.84	

Note: referent categories for indicator variables in italicized text

† p < .10; \* p < .05; \*\* p < .01; \*\*\* p < .001



or decrease in the predicted logged odds of low birth weight as compared to the reference group of the independent variable when the variable is dummy coded. A positive coefficient indicates that low birth weight is more likely and a negative coefficient indicates that low birth weight is less likely if a respondent falls into a certain category as compared to the reference group for each variable.

Model 1 is the simplest model and includes race and Beale county categories. The logged odds of low birth weight for completely rural counties are 0.454 higher than for large metro counties. The other county categories are not statistically different from large metro counties in their effect on the logged odds of low birth weight. The logged odds of low birth weight are 0.777 higher for Blacks than for Whites and are highly statistically significant. This means that the odds of a Black infant being low birth weight are over twice that of Whites ( $\exp(0.777) = 2.18$ ).

Model 2 includes interaction terms for race with Beale county categories. The total interaction effect of county categorization for Blacks is the sum of the first order effect of each county categorization and the interaction term for each county categorization ( $\beta_{\text{Beale}} + \beta_{\text{Interaction*Black}}$ ). For completely rural areas the total interaction effect for Black is therefore ( $-0.317 + 1.233 = 0.916$ ). This indicates that living in a completely rural county increases the odds of low birth weight  $\exp(0.916) = 2.5$  times for Blacks as compared to the odds for Whites in large metro counties. This odds ratio of 2.5 represents an additional source of inequality for rural Blacks, over and above the main effect of race. When an interaction term is included in model 2, the first order effect of living in a completely rural county becomes negative and loses its statistical significance.

This implies that the effect of living in a completely rural county compared to a large metro county lowers the odds of low birth weight for Whites. This is consistent with the descriptive results presented in figure 4.1. However, we cannot assert this conclusively because this result is not statistically significant in the second model. Also, the global fit of model 2 is not a significant improvement from model 1.

Total interaction effects for the other county categories with being Black can be calculated from the interaction terms included in model 2 in the same way as the interaction effect for completely rural and Black is calculated above. Interaction effects for all models are summarized in table 4.3. However, none of these interactions are statistically significant, meaning that we cannot conclude that there is any significant difference between Blacks and Whites in any of the county categorizations except for completely rural areas.

The first order effect of being Black in model 2 is consistent with model 1, indicating statistically significant odds of low birth weight  $\exp(0.588) = 1.8$  time higher, or 80% higher for Blacks than for Whites. This is slightly smaller in magnitude than the effect of race in model 1, indicating that part of the reason Blacks have higher odds of low birth weight is because Blacks in completely rural counties have higher odds of low birth weight, thereby bringing up the average.

Model 3 includes family and household composition variables to measure the degree that family support affects birth weight. The interaction term for Blacks living in a completely rural county remains statistically significant and positive. The total interaction effect of living in a completely rural county for Blacks is  $(-0.377 + 1.216 =$

**Table 4.3. Total Interaction Effects**

		First Order Effect - Beale	Interaction Term - Beale x Black	Total Interaction Effect - ( $\beta$ )	Total Interaction Effect - $\exp(\beta)$
Model 2	Small Metro	-0.252	0.248	-0.004	0.996
	Adjacent	0.149	0.217	0.366	1.442
	Non-Adjacent	0.037	0.292	0.329	1.390
	Rural	-0.317	<b>1.233</b>	<b>0.916</b>	<b>2.499</b>
Model 3	Small Metro	-0.251	0.264	0.013	1.013
	Adjacent	0.127	0.204	0.331	1.392
	Non-Adjacent	0.010	0.323	0.333	1.395
	Rural	-0.377	<b>1.216</b>	<b>0.839</b>	<b>2.314</b>
Model 4	Small Metro	-0.245	0.261	0.016	1.016
	Adjacent	0.172	0.059	0.231	1.260
	Non-Adjacent	0.030	0.251	0.281	1.324
	Rural	-0.344	<b>1.040</b>	<b>0.696</b>	<b>2.006</b>
Model 5	Small Metro	<b>-0.341</b>	<b>0.458</b>	<b>0.117</b>	<b>1.124</b>
	Adjacent	-0.094	0.574	0.480	1.616
	Non-Adjacent	-0.348	0.495	0.147	1.158
	Rural	-0.829	<b>1.510</b>	<b>0.681</b>	<b>1.976</b>

*Note:* statistically significant coefficients are in bold

0.839). Thus the odds of low birth weight are 2.3 times higher for Blacks when living in a completely rural county. This is very similar to the odds of low birth weight for Blacks in a completely rural county found in model 2, meaning that family composition does not explain the higher odds of low birth weight in the most rural areas for Blacks. However, the odds of low birth weight for Blacks sees a sizable reduction in model 3, going from 1.8 times more likely than Whites to 1.2 times more likely than Whites. Not only is the coefficient for the direct effect of race greatly reduced in model 3, it also loses statistical significance. This indicates that even though family structure does not explain the interaction between place and race, family structure has a significant influence on infant health for Blacks. More specifically, the presence of the mother's spouse or partner significantly reduces odds of low birth weight by 43%. The global fit of the model

improves significantly with the inclusion of family composition, as well (-2 log likelihood (-2LL) difference =  $3,027 - 2,988 = 38.79$  with 4 degrees of freedom; chi-square test yields  $p=0.000$ ).

Model 4 adds measures of the community to assess the mediating role of community level isolation on the odds of low birth weight. County unemployment rate is an indicator of community SES and is a reflection of the changing labor force in rural areas that leads to fewer low-skilled jobs. County percent Black is included as a measure of racial isolation. Population density is an indicator of spatial isolation. The only isolation measure that has a statistically significant effect on infant birth weight is county percent Black. There is a reduction in odds of low birth weight as the percent Black in the mother's county of residence increases. For example, in a county that is 50% Black, the odds of low birth weight is 30% lower than in a county that is 10% Black. This pattern contradicts expectations that a higher concentration of African Americans will result in worse infant health. This contradiction is most likely due to the false assumption that higher concentrations of poverty will accompany racial isolation in all areas, as it often does in urban areas (Massey and Fischer 2000; Wilson 1996). However, the reduced odds of low birth weight in counties with a larger Black population does make sense when strictly considering the effect of Black communities on the social support available to Black mothers. If social support is important to infant health, then Black mothers in communities with a higher concentration of Black residents would be supported better and have better infant health outcomes.

The interaction effect for Blacks living in a completely rural county is still strong and statistically significant. Living in a completely rural county increases the odds of low birth weight  $\exp(0.696) = 2.0$  times for Blacks as compared to the odds for Whites in large metro counties. The magnitude of the odds of low birth weight for Blacks in a completely rural county has decreased in model 4 as compared to model 3 which showed 2.3 times greater odds of low birth weight for Blacks in completely rural counties. However, living in a completely rural county still doubles the odds of low birth weight for Blacks, even after the inclusion of community isolation measures. This means that contrary to expectations, the community level measures of social isolation do not do a particularly good job at explaining the higher prevalence of low birth weight for Blacks in the most rural counties, although they explain some of the difference. The -2LL values between model 3 and model 4 are not significantly different ( $2988.0 - 2982.4 = 5.6$ ,  $df = 16 - 13 = 3$ ), reinforcing the lack of explanatory value in the community level isolation measures for determining the odds of low birth weight for Blacks in the most rural counties. However, the odds of low birth weight for the main effect of race/ethnicity is further reduced in model 4 for Blacks and is not statistically significant. The community level measures of isolation therefore have somewhat of an influence on infant health for Blacks.

Model 5 includes access to care variables, maternal SES variables, birth characteristics and maternal pregnancy behavior. In other words, this model looks at more direct determinants of infant health that are theoretically determined by distal influences such as the degree of social support. Many of the variables in this model are

statistically significant predictors of low birth weight, but do little to explain the higher odds of low birth weight for Blacks and for Blacks in the most rural counties. That is, the interaction effect for Blacks in the most rural county is still very strong and statistically significant, with the odds of LBW 1.98 times higher for Blacks in the most rural counties than for Whites in urban counties. The total interaction effect for Blacks in the most rural counties is comparable to previous models in magnitude. The odds of low birth weight for the first order effect of race are unchanged in model 5 as compared to model 4, remaining insignificant and small. The -2LL is significantly lower than the previous model (-2LL difference =  $2982.4 - 2182.8 = 799.5$ ,  $df = 43 - 16 = 27$ ; chi-square test yields  $p=0.000$ ), but this is probably due to the high number of variables included in this final model.

Some of the other variables in model 5 have a statistically significant effect on the odds of low birth weight as expected, even though they explain little about the race and place disparities focused on in this thesis. That is, the first order effect of race and the interaction effect of Blacks in the most rural counties remain largely unchanged as compared to the previous model. If the mother has no health insurance the odds of a low birth weight infant increases 42% and living below the poverty threshold also increases odds of low birth weight by 41%. Birth characteristics that increase the odds of low birth weight include twin or triplet births, male infants and gestational age of less than 37 weeks. Smoking cigarettes during pregnancy also greatly increases the odds of a low birth weight infant.

## CHAPTER 5

### DISCUSSION AND CONCLUSION

The main purpose of this thesis has been to add to previous literature by examining the interaction of rural and urban residence with race and ethnicity on the odds of low birth weight. Descriptive results indicated that Blacks had prevalence rates of low birth weight double that of Whites, supporting general patterns found in previous research (National Center for Health Statistics 2007). An interesting finding was the consistently higher odds of low birth weight for Blacks in the most rural county categorization along the rural/urban continuum. This pattern was not repeated for Whites, but rather, descriptive results suggest that the opposite may be true; the prevalence of low birth weight infants was lower for Whites in rural areas than for Whites in other areas. This was somewhat surprising considering that the only previous research that disaggregated by race/ethnicity and that also used a five category and nine category distinction for rural/urban residency was a descriptive study that found the opposite pattern for infant mortality rates based on data from the 1991 Bureau of Health Manpower Area Resource File (Farmer et al. 1993). It is also contrary to two studies that used a three category measure of rural/urban residency which found no difference in infant birth weight between rural and urban areas using vital statistics from the late 1980's from the states of Washington and Illinois (Larson et al. 1992; Rock and Straub 1994). However, this thesis supports the outcomes of several studies of rural and urban differences in infant health that found worse health in more rural places based on birth

and death certificates in Florida and hospital records in Iowa (Clarke and Coward 1991; Hulme and Blegen 1999). The separation of different racial and ethnic groups along the rural/urban continuum by examining the interaction effect of race and place has helped explain the contradictions between previous rural/urban health studies. The divergent direction of infant health patterns for Blacks versus Whites is a very important finding that should be recognized in future studies examining rural and urban health differences.

The odds of low birth weight were expected to be higher in the most rural areas as compared to the most urban areas. This hypothesis was supported until results were separated by race through the inclusion of interaction terms. When the interactions terms between race and residence were included, the effect of rural residence on the odds of low birth weight diverged for Blacks and Whites. That is, the increase in chances of low birth weight with rural residence only occurred for Blacks and not for Whites.

Blacks in rural areas were expected to have higher odds of low birth weight than Blacks in urban areas. This hypothesis was supported in the descriptive results as well as the multivariate results. Blacks in the most rural areas had the highest odds of low birth weight. The interaction between race and place had far less impact when not exacerbated by the isolation that exists in the least populated rural counties. Poor infant health for rural Blacks is an important finding when considering the lack of focus in previous literature on rural Black health. The results of this thesis highlight the importance of focusing on the health of rural Blacks in future studies.

Low birth weight disparities between Whites and Blacks were expected to be wider in completely rural areas than in the most urban areas. This hypothesis was



partially supported by the descriptive results. The disparity in low birth weight between Blacks and Whites was widest in the completely rural county category. Whites in the completely rural county category had the lowest percentage of LBW of all county categories for Whites and Blacks in the completely rural county category had the highest percentage of LBW of all county categories for Blacks. However, there was still a very large difference between Blacks and Whites in all county categories, especially for the large metro and small metro counties, so based on descriptive results alone, we cannot conclusively say that disparities between Blacks and Whites are wider in the most rural areas. However, the multivariate results also support this hypothesis. The interaction effect between race and the most rural county category tells us that there is a larger disparity in infant birth weight between Blacks and Whites in the most rural counties as compared to the most urban counties.

Family structure was expected to be an important mediator of the relationship between race, rural residence and the odds of low birth weight. The only aspect of family structure that was important was the presence of the mother's partner or spouse in the household. The presence of the father in the household explained the race effect almost entirely in models that also included variables for the type of county of residence and the interaction of race and county type. This result has larger social implications to the changes in socially dominant family structures and how they affect the social support available to a mother. The higher prevalence of single parent households for Blacks and especially for poor Blacks, leads to compounded disadvantage of poverty as well as a lack of social support for many Black mothers and their infants (England and Edin 2007).

It is important to emphasize that this result does not necessarily justify the preservation of traditional family structures, but rather, a need to ensure some relevant type of social support is available for pregnant women and mothers. Even though the preservation of traditional family structures is one solution to providing proper support to pregnant women and their children, it does not necessarily follow that this is the only relevant source of support. The finding that the presence of the father in the household completely explains the Black disadvantage in infant birth weight illuminates the great need to replace missing household level support to Black mothers, whether through traditional or nontraditional means.

Economic and community structures that were expected to be important mediators of the relationship between race, rural residence and the odds of low birth weight include the degree of racial isolation, class isolation and spatial isolation. The only noteworthy result indicates that the higher the percentage of African Americans in a county, the lower the chances of low birth weight infants in that county. This may be a reflection of the higher need for social support for single Black mothers, considering that many more of the low birth weight infants in this study were Black than were White, skewing the results to represent the needs of Blacks more than Whites. The chance of low birth weight for Blacks in the most rural counties was explained better after the inclusion of the economic and community structure variables than after the inclusion of any other set of explanatory variables.

However, limitations in the measurement of community support could have limited the conclusions that can be drawn from these results. The unemployment rate in

the county may not accurately reflect the average socioeconomic status of its residents, nor the degree of class separation in the county. Similarly, the percent Black does not necessarily reflect the degree of racial separation in the county. It is possible that a higher percent Black in a county simply reflects a higher degree of either racial clustering or of racial integration. The county population density does not necessarily reflect the distribution of the population within the county. It is very probable that counties with low population densities are still comprised of clustered communities.

The degree of racial isolation, class isolation, spatial isolation and family level isolation were hypothesized to affect the more direct social influences on infant health such as maternal SES, access to care, birth characteristics and the pregnancy behavior of the mother. Some of these more direct measures were good predictors of low birth weight, such as maternal poverty status, having health insurance, parity, plurality, gestational age and smoking behavior of the mother. However, these direct measures of infant birth weight did not support the theory that they are influenced by differences in the degree of social isolation faced by the mother. They also did little to explain why race and place are so influential to infant health. However, after controlling for individual SES and other such measures, the influence of place appears to become somewhat more influential, as evidenced by larger place-related coefficients and the emergence of two marginally significant terms. This may be due to a suppressor effect which requires further research to determine.

There were a few important limitations to this study that should be mentioned. First, this study was limited to county level place measures and place characteristics.

County level place characteristics may not be the best way to accurately capture community traits that are relevant to differences in low birth weight outcomes. It would be helpful to repeat this type of study using census tract or census block information. Second, the births analyzed in this study ranged between 1978 and 2005. Even though an attempt to control for period of observation did not yield substantively or statistically significant results, it is very possible that there have been unobserved changes in many aspects of rural America that could affect health outcomes for infants. It is certainly reasonable to suspect that what was defined as a rural county for a birth in 1978 is not entirely the same, substantively, as what was defined as a rural county for a birth in 2005, regardless of equivalence in population sizes and adjacency to urban areas. Advances in communication and transportation may make it easier for women to gain access to information and resources in more recent years. For instance, the internet has made information much easier to access in 2005 than in 1978. The social support of the mother may have changed with economic changes if family and community members left rural areas for urban areas in search of jobs. The rural economy, transportation improvements and internet access were not changed at uniform rates in all rural areas, and therefore, a period effect may not have been able to fully capture the implications associated with changes in time to the health of rural infants.

Overall, the results supported the hypotheses introduced in this thesis. The odds of low birth weight were highest among Blacks in rural counties. Interestingly, the results implied that rural residence had the exact opposite effect for Whites who most likely have reduced odds of low birth weight in the most rural counties as compared to

more urban counties. However, this was not entirely conclusive due to the lack of statistical significance for rural residence in this analysis and would merit further examination in future studies. Based on descriptive results we also know that, in general, low birth weight disparities between Blacks and Whites were wider in the most rural counties as compared to more urban counties.

Another interesting aspect of this study was that many of the variables in the model did little to explain why Blacks in the most rural areas had such a high prevalence of low birth weight infants. The first order effect of race on low birth weight was reduced in size and significance in most of the models, while the interaction effect of being Black in the most rural counties retained a strong effect on the odds of low birth weight throughout all models. Even though the first order effect of race was explained quite well by the presence of the father in the household and other variables, the negative infant birth weight outcomes for Blacks in the most rural areas remain largely unexplained.

The most significant implication of this work is that examining the needs of Blacks in the most rural areas is just as important as examining the needs of Blacks in urban areas. Previous emphasis has been placed on minority urban populations. This research has shown that minority rural populations may be in just as much need of policy and program development in order to meet the specific needs of under recognized groups within the rural population, such as African Americans.

In conclusion, disaggregating place along the rural/urban continuum and examining its interaction with race leads to different patterns for Blacks than for Whites.

Curiously, most of the expected explanatory variables for low birth weight of Blacks in the most rural counties did little to explain the worse health for Black infants in rural counties. Other explanations for why rural Blacks have higher odds of low birth weight should be explored in future research. These results add another dimension to previous debates of the effect of rural versus urban residency on infant health by illuminating the existence of this double jeopardy created by place and race.

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