Disparities in Birth Weight between Non-Hispanic Blacks and Non-Hispanic Whites: The Effect of Rural Residency

Theresa M. Fedor, University of Pennsylvania
E. Helen Berry, Utah State University
Eric N Reither, Utah State University

Abstract

This research assesses the prevalence of low birth weight among non-Hispanic Blacks and non-Hispanic Whites along the rural/urban continuum. Degree of social isolation and lack of social support are proposed mechanisms for explaining the high prevalence of low birth weight observed among Blacks in rural counties. Using data from the National Longitudinal Survey of Youth 1979 and the National Longitudinal Survey of Youth 1979 Child data, the relative odds of low birth weight were estimated for Black and White women via logistic regression. Living in a predominately rural county exacerbates disparities in birth weight outcomes between Blacks and Whites. The odds of low birth weight among Blacks in the most rural locales are about two times higher than Whites in urban areas. Logistic regression models also revealed that racial disparities in low birth weight were almost completely accounted for by the presence of the father in the household when interactions effects for place of residence were also included in the model. Our results highlight the importance of place of residence and family structures for health outcomes among racial minorities.

Introduction

Infant health has been shown to have lifelong repercussions, affecting susceptibility or resistance to many health conditions in adulthood (Elo & Preston, 1992; Hayward & Gorman, 2004; Rich-Edwards,Kleinman, Michels, Stampfer, Manson, Rexrode, et al., 2005). Yet even in more developed countries such as the United States, infant health is unequally distributed by race, class, and geographic residence (National Center for Health Statistics, 2007). Disconcertingly, in the U.S. rates of low birth weight, infant mortality and small for gestational age births are approximately two times higher for non-Hispanic Blacks (Blacks) than for non-Hispanic Whites (Whites) (National Center for Health Statistics, 2007; Elo, Culhane, Kohler, O'Campo, Burke, Messer, et al., 2009; Reichman, Hamilton, Hummer & Padilla, 2008). Black mothers are more likely to be single, a factor associated with isolation and lesser support during pregnancy (England & Edin, 2007). At the community level poor Blacks are more often concentrated in racially and economically isolated neighborhoods (Massey & Fischer, 2000; Williams & Collins, 1995; Wilson, 1996). Infant health has been shown to be adversely affected when there is less support for mothers, a situation that is often the case when there is economic isolation (Collins & Butler, 1997; Collins, David, Symons, Handler, Wall & Symons, 1998; Grady, 2006; Grady & Ramirez, 2008; Howell, 2008). Furthermore, geographic isolation likely exacerbates the impact of being single, poor, and Black. Yet the extent of racial disparities in infant health in rural, geographically isolated places as compared to urban areas, has not been extensively analyzed and deserves exploration with consideration given to the impact of geographical and community level influences on infant health.

Previous research on racial and ethnic disparities in infant mortality and birth weight has tended to focus on the needs of the urban poor because this group is often identified as experiencing the worst infant health status within the United States (Auger et al., 2008; Collins et al., 1998; Grady, 2006; Grady & Ramirez, 2008; Hearst, Oakes, & Johnson, 2008; Howell, 2008; Inagami, Borrell, Wong, Fang, Shapiro, & Asch,, 2006; Kramer & Hogue, 2008). However, when considering health outcomes along a continuum of rural and urban classifications, more rural areas often exhibit poorer health profiles (Auchincloss & Hadden, 2002; Clarke & Coward, 1991; Hillemeier, Weisman, Chase, & Dyer, 2007; Hughes & Rosenbaum, 1989; Ormond, Zuckerman, & Lhila, 2000). To develop policies capable of addressing laudable public health goals to reduce health disparities while also extending the quantity and quality of life, researchers must better understand how rural areas impact infant health and contribute to racial health disparities.

The focus of this research is to explore how rural areas differentially affect infant birth weight for Blacks and Whites. Specifically, the joint influence of being Black and living in more rural areas along the rural-urban continuum is expected to exacerbate negative infant health outcomes. Social isolation and lack of social support at both the individual level and the community level are proposed as the mechanisms that mediate the hypothesized worse infant health outcomes for Blacks in rural areas. 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.

Background

The Importance of Infant Health

Low birth weight or poor health during childhood can affect an individual's chances of developing a myriad of health problems later in life and increase the risk of mortality (Elo & Preston, 1992). Low birth weight is a leading cause of infant mortality (National Center for Health Statistics, 2008) and, when extended into adulthood, is associated with increased risk of coronary heart disease, stroke and many other poor health outcomes (Almond, 2006; Barker, 1992; Rich-Edwards, et al., 2005; Roseboom, van der Meulen, Ravelli, Osmond, Barker, & Bleker, 2001).

Disparities in low birth weight and associated infant health between racial and ethnic sub-groups within developed societies illuminate persistent disadvantage and inequality (Singh & Yu, 1995). Evidence exists for differences in health between Black and White infants during gestation (National Center for Health Statistics, 2007; The United Nations Children's Fund & World Health Organization, 2004), making birth outcomes and infant health one of the first access points for the documentation of inequality and disadvantage that lasts a lifetime, as well as one of the earliest points in the life-cycle when efforts can be made to reduce this inequality.

The health of a mother and her infant are dependent on many aspects of the woman's life, but maternal and child health tend to be associated with a few key social and behavioral factors: pregnancy and child care knowledge, behavior or a lack of positive behavioral influences, social isolation or a lack of childcare and pregnancy support, and economic disadvantage or a lack of financial support (Colen, Geronimus, Bound & James, 2006; Haas, Phillips, Sonneborn, McCulloch, Baker, Kaplan, et al., 2004; Miller, Clarke, Albrecht, & Farmer, 1996; Schempf, Branum, Lukacs & Schoendorf, 2007; Zhang & Harville, 1998). These four variables are shaped by economic, family and community structures that in turn are strongly 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 disadvantages facing Blacks and rural populations.

Family Structure: Social Isolation at the Household Level

The socially oriented roots of inequity experienced by Black mothers 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. The 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 low levels of education and income are even less likely to be married (Bennett, Bloom, & Craig, 1989; England & Edin, 2007). Over the past few decades it has also become more prevalent and more socially acceptable to have a child outside of marriage, regardless of race (Bumpass, 1990; Thornton & Young-DeMarco, 2001); this occurs more often for Blacks, for women with lower education levels, and for women with lower incomes (England & Edin, 2007).

Living as a single mother may undermine the level of family support available to the mother and the child, which has been shown to have a negative effect on infant health (Campos, Schetter, Abdou, Hobel, Glynn, & Sandman, 2008; Colen et al., 2006; Hogan, Hao, & Parish, 1990; Kana'Iaupuni, Donato, Thompson-Colón & Stainback, 2005; Sherraden & Barrera, 1997). This is not to say that the traditional nuclear family is the only effective support structure for women and their children. Rather, research shows that the presence of any other adult in the household during pregnancy and childbearing greatly increases the support received by the mother. Increased family support is positively associated with higher infant birth weight and better general infant and child health (Campos et al., 2008; Kana'Iaupuni et al., 2005; Sherraden & Barrera, 1997). In Black families the presence of the grandmother in the household has been associated with better infant and child health as compared to Black households without a grandmother (Colen et al., 2006). However, absent fathers are more likely in Black than White households (England & Edin, 2007) implying that the overall level of family support may still leave Black mothers at a disadvantage.

Geographically, single motherhood is especially prevalent in impoverished and socially isolated Black communities (England & Edin, 2007). Rural areas tend to have higher levels of poverty, as well as poor health outcomes which are often associated with poverty (Auchincloss & Hadden, 2002; Farmer, Clarke, & 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.

Rural Economic Structure: Social Isolation at the Community Level

In rural areas, isolation and poverty have been exacerbated by the evolving economy of rural America across the second half of the twentieth century. The result has been changes in the types of jobs available for the less educated. There have been decreases in higher paying jobs in farming, ranching, manufacturing and mining, which have been only partially offset by increases in low paying, service-based employment (Brown & Kandel, 2006; Johnson & Cromartie, 2006; Kirschner, Berry, & Glasgow, 2006). One consequence of these economic changes has been a large exodus of young adults from rural areas hoping to seek employment elsewhere (Johnson & Cromartie, 2006).

A potential implication of this rural exodus on mothers who remain is smaller peer groups. The exodus of youth is thought to have negative ramifications 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.

A lower concentration of employment in goods production (farming and manufacturing) and a higher concentration in low-skilled service production has a detrimental impact on rural places because the service industry generally pays much less, and is less likely to be unionized than the farming and manufacturing industries of the past (Kirschner et al., 2006; Wilson, 1996). The replacement of jobs in farming, mining and manufacturing with 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 farming and manufacturing jobs with a fewer number of service sector jobs.

Rural areas often have higher levels of poverty and lower education levels which are associated with worse health outcomes (Auchincloss & Hadden, 2002; Farmer et al., 1993; Ormond et al., 2000). For instance, women who live in poverty or who have lower levels of education are more likely to have low birth weight infants (Clarke & 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 of greater social isolation and higher poverty rates, which has been exacerbated by economic changes in rural areas.

Black Economic Disadvantage and Residential Segregation

Economic disadvantage and spatial isolation are more prevalent in Black communities, leading to concentrated poverty and racial isolation (Massey & Fischer, 2000; Wilson, 1996). Concentrated poverty and racial isolation have been found to affect infant health negatively (Collins & Butler, 1997; Collins et al., 1998; Grady, 2006; Grady & Ramirez, 2008; Howell 2008). Both the racial context and the socioeconomic context of a place are important 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 are 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 & Fischer, 2000; Wilson, 1996). A large body of scholarship has documented the negative impact of the physical separation of African Americans. For example, 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). In general, fewer economic opportunities, fewer public resources and negative environmental factors tend to be concentrated in neighborhoods with high percentages of Black residents (Massey & Fischer, 2000; Williams & 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 observed disparities in infant birth weight between Whites and Blacks.

Infant Health Variation and the Definition of Rural and Urban Residency

Differences in health based on rural or urban residency vary greatly depending on what aspect of health is being measured as well as the way that rural and urban are defined. 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 & Straub, 1994). The same outcome is sometimes true when a third category is created by adding a distinction for adjacency to metro areas (Larson, Hart, & Rosenblatt 1992). However, 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 & Hadden, 2002; Clarke & Coward, 1991; Farmer et al., 1993; Ormond et al., 2000). For both Blacks and Whites, suburbs have been shown to have the best health outcomes—a finding that 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 differentials surface. In one 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 had higher rates of infant mortality than Whites in urban areas (Farmer et al., 1993). Because these results are in opposition to patterns of infant health based on degree of rurality alone, they illuminate the need for multivariate analysis to assess how race and rural/urban residency relate to infant health and work in tandem to affect infant health. This research addresses this issue by examining the joint influence of race and rural/urban residence on infant birth weight.

In sum, birth weight differences based on race and place of residence are expected to be partially explained by variation in family and household structure, as well as the economic and social characteristics of the county of residence that define the degree of racial, economic, spatial and social isolation. 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 influence of economic, family and community structures is expected to have the most negative impact among Blacks and in the most rural counties through the mechanisms of race, poverty 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 research is designed to illuminate not only racial disparities in birth weight by place of residence, but also the mechanisms responsible for those disparities.

Data and Methods

Sample

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 NLSY surveys include a nationally representative cross-sectional sample; an oversample of Hispanics, Blacks and economically disadvantaged Whites; and an oversample of military personnel. The NLSY79-C data uniquely identifies all births to women in the original NLSY79 dataset. There are a total of 5,196 White and Black infants in this analysis, with 459 of these infants of low birth weight (below 2500 grams at the time of birth, excluding outliers). A total of 532 cases were excluded from the analysis because these children were born to NLSY79 mothers prior to NLSY collection of data (births prior to 1978). The cases that are missing data on geographic location, as measured using Federal Information Processing Standard (FIPS) county codes that are used to uniquely identify each county in the 50 U.S. states (895), birth weight (793), and all other remaining variables (138) are also excluded from the analysis.

The dependent variable used in this analysis is a dichotomous variable for low birth weight (LBW). LBW is defined as less than 2,500 grams, or approximately 5.5 pounds at birth (National Center for Health Statistics, 2007). Four outliers (defined as birth weight less than 300 grams or more than 8,000 grams) were removed from the analysis sample.

Race is defined using the NLSY79 sampling frame that identified respondents as non-Hispanic White, non-Hispanic Black, Hispanic or other. An indicator variable was created to define each mother as either non-Hispanic White or non-Hispanic Black, after the exclusion of those reporting as Hispanic or other. Mother's race/ethnicity was used instead of child's race because the analysis focuses on the characteristics of the mother before and during pregnancy that are presumed to affect infant birth weight.

Residence was constructed using the FIPS codes for the mother. The FIPS codes identify the county of residence for respondents during each year of the survey. Counties can be large and can obscure the relationships between urban and rural settings, particularly in the western U.S. This imperfection of using counties as a measure is counterbalanced by the county being the smallest geographic unit that has temporally defined and recognizable boundaries.

The county of the mother's residence during the year of the child's birth is assigned a category based on the Economic Research Service's (ERS) rural-urban continuum codes (Economic Research Service 2004). The continuum codes, also known as Beale codes, define how rural or urban a county of residence is, and have been collapsed into five distinct groupings for the purposes of this study: (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. Combining continuum codes is done in order to have enough cases in all urban/rural categories to produce stable estimates, while preserving the integrity and validity of the original categorization scheme (Auchincloss & Hadden, 2002; Cromartie & Swanson, 1996).

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. These include mother's marital status, the presence of the infant's father or grandmother in the household, county percent unemployed, county percent black and county population density. The following variables pertaining to access to care, maternal socioeconomic status (SES), birth characteristics and maternal behavior are also included in later models: health insurance, trimester of first prenatal care visit, the number of physicians in the county per 100 residents, maternal education level, maternal employment status, maternal poverty status, mother's age at birth, plurality (whether the child is a twin or a triplet), the sex of the child, parity (whether this is a first, second, third, etc. birth), gestational age, prenatal vitamin use, alcohol use during pregnancy and cigarette smoking during pregnancy.

Analysis

A contingency table of low birth weight by race/ethnicity and county categorization is used to assess percentage differences in low birth weight for Blacks and Whites along the rural urban continuum. Pearson chi-square tests determine the statistical significance of low birth weight differences between Blacks and Whites in each of the five county categorizations.

Logistic regression models are also utilized to assess the significance and direction of the effects of race/ethnicity and place of residence on the odds of low birth weight. Interaction terms between race/ethnicity and place of residence provide a formal means of assessing the joint effect of these factors on low birth weight, net of other covariates in our models. Model 1 begins by analyzing the effects of the main independent variables for race and place residence. Model 2 builds upon this by adding interaction effects just described. In order to examine possible mechanisms responsible for the effects observed in Models 1 and 2, Model 3 adds household composition variables and Model 4 includes measures of community isolation. Finally, Model 5 adds access to care measures, maternal SES, birth characteristics and maternal behavior during pregnancy.

Results

Blacks and Whites have different prevalence and unique patterns of low birth weight. The percentage of low birth weight in this cohort is 6.4% for Whites and 12.8% for Blacks. Based on births to the NLSY79 mothers, Black infants are twice as likely to be low birth weight compared to White infants.

Figure 1 shows that the distribution of low birth weight between the five categories of rural and urban residency is very different for Blacks and for Whites. Birth weight disparities are much wider in the most rural areas than in any other place category. In large metro, small metro, adjacent to metro and larger non-adjacent counties, the prevalence of low birth weight ranges between 1.92 to 2.22 times higher among Blacks than Whites. In the most rural, non-adjacent counties the Black percentage of low birth weight is 6.10 times the percentage for Whites. The statistical significance of this disparity is exhibited with chi-square tests for each of the five county categories in Table 2. The prevalence of low birth weight is significantly different for Blacks and Whites for all county categories, though the coefficient for nonmetro counties that are adjacent to metro counties is only marginally significant ($p < 0.10$).

For Whites there is no clear pattern of differences in low birth weight between rural and urban counties. The 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, and the highest prevalence is 25.0% in the most rural county category. This indicates a much higher occurrence of low birth weight for Blacks in rural areas than in urban areas.

Table 3 reports regression coefficients (β) and standard errors (S.E.) for each independent variable in the logistic regression analyses. Model 1 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 ($p < 0.05$). The odds that a Black mother will give birth to a infant of low birth weight are about twice that of Whites ($\exp(0.777) = 2.18$), as expected.

Model 2 includes interaction terms for race with Beale county categories. Interaction effects for all models are summarized in Table 4. 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 ($\beta_{Beale} + \beta_{Interaction*}$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 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 interaction terms for race by residency are included in Model 2, the effect of living in a completely rural county changes sign and is not statistically significant, implying that the effect of living in a completely rural county has minimal influence on the odds of low birth weight for Whites. This is consistent with the descriptive results presented in figure 4.1. Despite the strong interaction term observed between race and rural counties, the global fit of Model 2 is not a substantial improvement over the first model.

Model 3 includes family and household composition variables to estimate the impact of family support on birth weight. The interaction term for Blacks living in a completely rural county remains significant and virtually unchanged from Model 2, suggesting that family composition does not explain the higher odds of low birth weight in the most rural areas for Blacks. However, even though family structure does not explain the interaction between place and race, our results clearly indicate that family structure has a substantial influence on low birth weight among Blacks. That is, the main effect of race/ethnicity is dramatically reduced when controlling for these variables, declining from 0.588 ($p < 0.001$) to 0.172 ($p > 0.10$). The presence of the father or the mother's current partner in the household is the most powerful covariate in Model 3 ($\beta = -0.566$, $p < 0.01$), reducing the odds of low birth weight by 43% and presumably accounting for most of the reduction in the main effect of race/ethnicity.

Model 4 adds measures that describe the county in which the mother and child reside. These are included to assess the mediating role of community level isolation on the odds of low birth weight. 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. As an 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 & 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 better supported and have better infant health outcomes. The main effect of race on low birth weight is reduced even further from the previous model and is nearly completely explained by the addition of the isolation variables. Furthermore, the interaction effect for Blacks living in the most rural counties is still strong and statistically significant in Model 4. Living in a completely rural county still doubles the odds of low birth weight for Blacks, even after the inclusion of community isolation measures (Table 3). 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.

Model 5 examines more proximate determinants of infant health, including access to care variables, maternal SES variables, birth characteristics and maternal pregnancy behavior. 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. To the contrary, the interaction effect for Blacks in the most rural counties increases in magnitude relative to Model 4 and remains statistically significant ($p < 0.05$), with the odds of low birth weight 1.98 times higher for Blacks in the most rural counties than for Whites in urban counties. Variables of particular interest in Model 5 include health insurance and poverty; mothers without health insurance experience a 42% increase in the odds of a low birth weight infant, and mothers living below the poverty threshold experience a 41% increase also increases odds of a low birth weight infant.

Discussion

The odds of giving birth to an infant below 2,500 grams are consistently higher among Blacks in the most rural counties of the rural/urban continuum. This finding was not repeated for Whites, who exhibited no particular patterning of effects between birth weight and place of residence. In fact, the prevalence of low birth weight infants was *lower* for Whites in rural areas than for Whites in all other areas. This was somewhat surprising considering that the only previous research that disaggregated by race/ethnicity and that also used a multi-category distinction for rural/urban residency was a descriptive study finding an opposite pattern for infant mortality rates based on data from the 1991 Bureau of Health Manpower Area Resource File (Farmer et al., 1993). The result also contradicts several other studies (Larson et al., 1992; Rock & Straub, 1994), but supports research that found worse infant health in more rural places (Clarke & Coward, 1991; Hulme & Blegen, 1999). Therefore, the separation of different racial and ethnic groups along the rural/urban continuum has helped explain the contradictions between previous rural/urban health studies. The divergent direction of infant health patterns for Blacks versus Whites is an important finding that should be recognized in future studies examining rural and urban health differences.

Family structure was expected to mediate the relationship between race, rural residence and the odds of low birth weight. The presence of the father or the mother's partner in the household was indeed important—the inclusion of this variable virtually eliminated the direct effect of race on the odds low birth weight. 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 apparently compounds the disadvantage of poverty and the lack of social support (England & Edin, 2007). While it might be unwise or unrealistic policy to place undue emphasis on traditional family structures, it is clearly essential to ensure that meaningful and sustained social support is available for pregnant women and mothers. The finding that the presence of the father in the household mediates 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 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 reflect that social support is higher where racial isolation is lesser, regardless of geographic isolation. The odds of low birth weight for Blacks in the most rural counties were explained better after the inclusion of the economic and community structure variables than after the inclusion of any other set of explanatory variables, although there is still double the chance of a low birth weight infant for Blacks in rural counties.

Limitations in the measurement of community support suggest some caution in interpreting these results. The unemployment rate in the county may not accurately reflect the average socioeconomic status of residents, nor the degree of poverty. 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 racial clustering. Neither does county population density necessarily reflect the distribution of the population within the county: counties with low population densities are often comprised of clustered communities.

The degree of racial isolation, class isolation, spatial isolation and social isolation (family and community) were hypothesized to be affected by 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 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 suggesting a possible suppressor effect.

Conclusions

Overall, the results supported the hypotheses introduced in this research. The odds of low birth weight were highest among Blacks in rural counties. Results suggest that rural residence had the exact opposite effect for Whites, who appear to 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 power for rural residence in this analysis. Based on descriptive results we 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.

Perhaps the most interesting aspect of this study was that the racial difference in prevalence of low birth weight between Blacks and Whites was nearly completely statistically explained in models that included interaction effects for race and degree of rural residency, as well as family and community support variables. That is, the racial disparity in low birth weight is largely dependent on place of residence and level of support. Still, even though the first order effect of race was accounted for by the presence of the father in the household and other support variables, the negative infant birth weight outcomes for Blacks in the most rural areas remain largely unexplained. Few of the variables in the model did much to explicate why Blacks in the most rural areas had such a high prevalence of low birth weight infants. The main 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.

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 sum, disaggregating place along the rural/urban continuum and examining the interaction of place with race shows different patterns for Blacks than for Whites. Curiously, most of the expected explanatory variables for Black low birth weight 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. First, it should be noted that not all rural places are equal – the most rural places are at greater disadvantage. Second, the results add another dimension to previous debates of the effect of rural versus urban residency on infant health by illuminating the existence of the double jeopardy created by place and race.

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Table 1. Pearson Chi-Square (χ^2) Test of Significant Racial Differences in Low Birth Weight (LBW) for Each County Categorization

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

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

Table 2. Low birth weight by race and geographic residency regressed on Interactions and Factors associated with LBW

	Model 1		Model 2		Model 3		Model 4		Model 5	
	β	S.E.	β	S.E.	β	S.E.	β	S.E.	β	S.E.
Main Independent Variables:										
Race/Ethnicity (*Non-Hispanic White*)										
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 (*Large Metro Area*)										
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 (*Non-Hispanic White X Large Metro Area*)										
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
Family/Household Composition:										
Father or Mother's Partner (*Not Present)*										
Present in Household					-0.566**	0.205	-0.557**	0.206	-0.544*	0.232
Grandmother or Great Grandmother (*Not Present*)										
Present in Household					-0.035	0.135	-0.048	0.135	0.000	0.171
Marital Status (*Married*)										
Never Married					0.229	0.203	0.247	0.205	0.015	0.241
Divorced, Seperated or Widowed					0.172	0.235	0.169	0.236	-0.232	0.279
Community Isolation:										
County Unemployment Rate (*continuous*)							0.000	0.017	0.016	0.021
County Percent Black (*continuous*)							-0.009*	0.004	-0.012**	0.005
County Population Density (*continuous*)							0.000	0.000	0.000	0.000
Sample Size (*n*)	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 2. (Continued).

	Model 1		Model 2		Model 3		Model 4		Model 5	
	β	S.E.	β	S.E.	β	S.E.	β	S.E.	β	S.E.
Access to Care:										
Prenatal Care (*Began During First Trimester*)										
Second Trimester									0.131	0.161
Third Trimester									0.197	0.252
Health Insurance (*Yes*)										
Not Insured									0.350†	0.189
Missing Data									0.079	0.186
Physician Rate per 100 residents (*continuous*)									1.151†	0.595
Maternal SES Variables:										
Educational Status (*High School*)										
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 (*Above Poverty Threshold*)										
Below Poverty Threshold									0.341*	0.164
Missing Data									-0.262	0.199
Occupational Status (*Employed*)										
Unemployed									0.192	0.224
Not in Labor Force									0.050	0.152
Sample Size (*n*)	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 2. (Continued).

	Model 1		Model 2		Model 3		Model 4		Model 5	
	β	S.E.	β	S.E.	β	S.E.	β	S.E.	β	S.E.
Birth Characteristics & Maternal Behavior:										
Age of Mother at Birth (*20 to 35 years old*)										
Teen Mom (under 20 years old)									-0.280	0.205
Older Mom (over 35 years old)									0.418	0.269
Single or Multiple Birth (*Singleton Birth*)										
Twin or Triplet Birth									2.867***	0.268
Child's Sex (*Female*)										
Male									0.368**	0.117
Parity/Child's Birth Order (*2nd or 3rd Birth*)										
First Birth									0.099	0.134
Higher Order Birth (4th or higher)									-0.132	0.216
Gestational Age (*Normal Age or greater than 37 Weeks*)										
Short Gestational Age or less than 37 Weeks									2.773***	0.122
Vitamins Taken During Pregnancy (*Yes*)										
No Vitamins									0.035	0.263
Missing Data									0.177	0.238
Alcohol Use During Pregnancy (*No Alcohol*)										
One to Four Days a Month									-0.012	0.141
One to Four Days a Week									0.243	0.251
Daily or Nearly Every Day									0.309	0.623
Cigarette Smoking During Pregnancy (*Non Smoker*)										
Less Than One Pack a Day									0.390**	0.145
One or More Packs a Day									0.931***	0.195
Sample Size (*n*)	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 3. Total Interaction Effects for Low Birth Weight by Race and County Categorization

		Main Effect - Beale	Interaction Term - Beale x Black	Total Interaction Effect - (β)	Total Interaction Effect - exp(β)
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	**1.233**	**0.916**	**2.499**
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	**1.216**	**0.839**	**2.314**
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	**1.040**	**0.696**	**2.006**
Model 5	Small Metro	**-0.341**	**0.458**	**0.117**	**1.124**
	Adjacent	-0.094	0.574	0.480	1.616
	Non-Adjacent	-0.348	0.495	0.147	1.158
	Rural	-0.829	**1.510**	**0.681**	**1.976**

Note: coefficients statistically significant at .05 or better are in bold

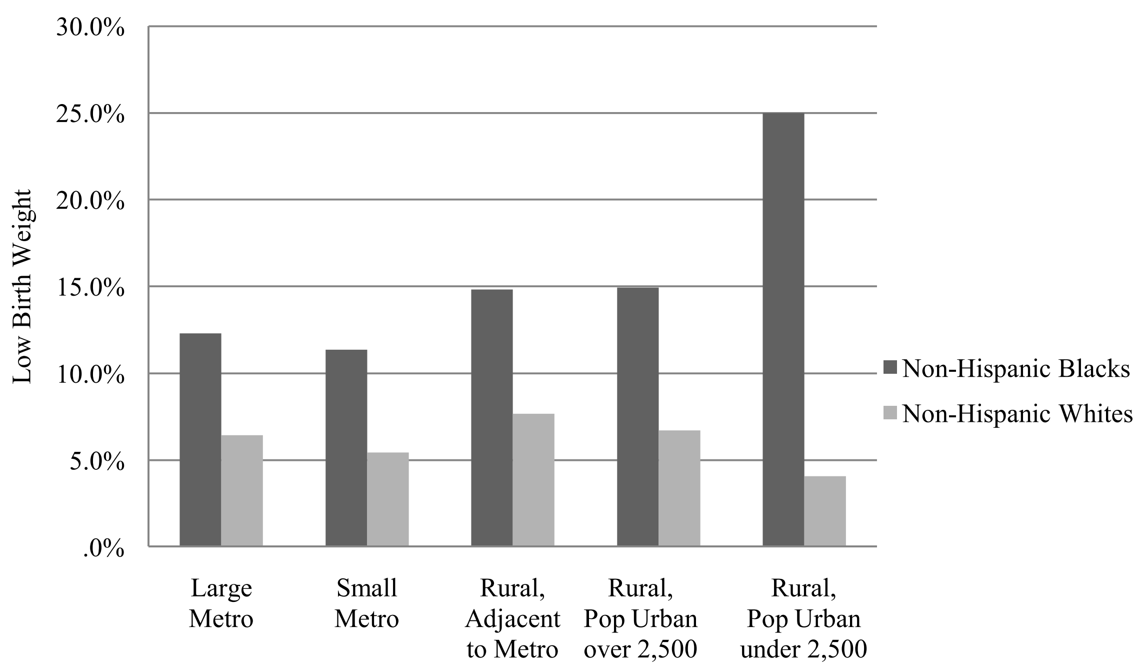

Figure 1. Percentage Low Birth Weight by Race and County Categorization, (n = 5,196 weighted to represent the U.S. population)