THE HISPANIC HEALTH PARADOX THROUGH A NEW LENS:

SPATIAL CLUSTERING AND BIRTH OUTCOMES IN THE RURAL SOUTHEAST

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A thesis submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Master of Arts in the Department of Sociology.

Chapel Hill

2010

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ABSTRACT

HEATHER B EDELBLUTE: The Hispanic Health Paradox through a New Lens:
Spatial Clustering and Birth Outcomes in the Rural Southeast
(Under the direction of Barbara Entwisle)

The new era of immigration is one where immigrant populations are settling in non-traditional places, such as rural areas in southeast, with a migration pattern characterized by its speed. The place and space surrounding these immigrants is different than in traditional gateway cities and requires new approaches for measuring social processes surrounding these groups. This research examines whether the health advantage that Latino immigrant women have over adverse birth outcomes persists in a rural county in North Carolina with two immigrant populations, one from Mexico and the other from Central/South America. Using geocoded birth records, the assimilation and social network aspects of the Hispanic health paradox are explored through the creation of a birth clustering variable in ArcGIS. The birth clustering variable measures inferred co-ethnic concentration of immigrant mothers in a mother's neighborhood. The effect that co-ethnic concentration has on birth outcomes is discussed in this paper.

ACKNOWLEDGEMENTS

I would like to offer my sincerest thanks to my advisor and the chair of my committee, Dr. Barbara Entwisle. I am grateful for all of her support and advice during the process of completing this research. I would like to thank Dr. Kyle Crowder and Dr. Jacqueline Hagan for their thoughtful comments and constructive criticisms. I would also like to thank spatial analyst Philip McDaniel at the Carolina Population Center for his advice on how to develop spatial components of this research. Finally, I would like to acknowledge the two years of generous support I have received through the Carolina Population Center pre-doctoral research traineeship.

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"CA/SA" refers to immigrants from Central America or South America in the tables and figures in this paper.

STUDY AIMS

Until recently, much of the media and scholarly attention paid to Latino[1] immigration in the United States has focused on traditional receiving states in the southwest and large cities with established migration streams, such as Miami and New York. Rapid demographic shifts over the past 20 years have resulted in what many scholars are calling the "new south" (Suro & Singer, 2002). Once an area characterized in demographic terms as being black and white, the south has become increasingly diverse across ethnic lines due to industrial restructuring. Old forms of production, such as steel, textiles, and apparel have been undermined by this economic transformation as new sources of economic investment have flowed into the region (Douglas S Massey, 2010). This economic growth and restructuring of industries, such as meatpacking, have resulted in many working class blacks and whites moving into other occupations and employers recruiting Latin American immigrants into the worst low-wage jobs (Kandel & Parrado, 2005). As a result, the US South today is becoming increasingly diverse, but with a segmented labor force, featuring high tech research, manufacturing, agriculture, and service sectors. North Carolina represents a state in the "new south." Its Latino population has increased by 400% since 1990 (North Carolina State Center for Health Statistics and Office of Minority Health and Health Disparities, 2006; US Census Bureau, 1990, 2007).

The recent demographic shift in the southeast carries with it an increase in Latino births. Latino immigrant populations in the southeast and elsewhere in the United States are

[1] "Latino/a" and "Hispanic" are used interchangeably in this paper.

usually younger than the general population (US Census Bureau, 2005-2007) and have higher fertility than other groups (Martin et al., 2007). Interestingly, Latino immigrants represent a puzzle for researchers concerned with the social context surrounding birth outcomes. Despite compromised socioeconomic situations and limited access to care, Latino immigrants generally have healthier babies than other minority groups in the United States (Franzini, Ribble, & Keddie, 2001). This paradox has been found countless times with mothers from Mexico consistently having the greatest protective benefit from adverse birth outcomes than other groups (de la Rosa, 2002; Fuentes-Afflick, Hessol, & Perez-Stable, 1999; Hummer, Powers, Pullum, Gossman, & Frisbie, 2007). Not as clear in the literature is whether this benefit is limited to those in traditional receiving areas or accrues for immigrants living in a diversity of communities.

Much of the research on this health paradox has used large samples of aggregated birth outcome data for either a metropolitan area, state, or large geographic area. There is a paucity of research on birth outcomes for Latino immigrants in rural areas of the United States or in this new south. Immigrants in rural communities may experience heightened discrimination (Zúñiga & Hernández-León, 2005), especially since these areas typically lack ethnic diversity when compared to traditional gateway cities (Winders, 2009). A lack of English language proficiency may lead to the perception that immigrants are unwilling to learn English and result in an anti-immigrant sentiment in rural areas (Zúñiga & Hernández-León, 2005). Experiences of discrimination for Latino immigrants in combination with socioeconomic disadvantage in this geographic context could produce a physical consequence that impacts health (Williams, Neighbors, & Jackson, 2008). Thus, place may mean something different for immigrant women in rural areas than for immigrant women in

traditional receiving areas. In addition, the literature has not determined whether enclaves of Latino immigrants in rural areas have better birth outcomes than immigrants living in other neighborhood contexts. To date, only two studies have been published that look at the role of spatial patterning of births in birth outcomes for Latino immigrants. Both of these studies were limited to Latino populations in urban areas in California (Peak & Weeks, 2002; Peete, 1999) and did not distinguish between native and foreign-born Latinos. Thus, it is not clear whether a spatial clustering of births, or the tendency of individuals to live close to others with similar cultural backgrounds, provides protection against adverse birth outcomes for immigrants. Perhaps Latino immigrant women who live in close proximity to other women with similar cultural backgrounds where maternity is highly valued receive more social support during their pregnancies. They may also live in a neighborhood context where norms regarding maternity create an environment conducive to a healthy pregnancy. Finally, much of the research on birth outcomes for immigrant groups focuses on immigrants from Mexico or the Caribbean.

This study offers the unique opportunity to examine the social context of immigrants from Mexico, and Central and South America in a rural county in the southeast and provides a theoretically interesting opportunity to examine the Hispanic health paradox and the role of a spatial clustering of births in birth outcomes. Specifically, it asks:

> Q1: Does the advantage that Mexican born women have with respect to low birthweight persist in a rural setting in the United States?
>
> Q2: Do birth outcomes vary according to nativity status for immigrants from Mexico, and Central and South America?
>
> Q3: Does the spatial clustering of immigrant and minority populations affect birth outcomes, especially in relation to the majority white population?

Birth outcomes are salient in sociological research since they are indicators of the health of populations. While infant mortality is used to compare countries and groups at a national or state level, low birthweight (LBW) is an appropriate measure to ascertain the reproductive health of populations at the county level in the United States. Low birthweight (>2500 grams or 5lb 8oz) is the birth outcome examined in this study and is known to affect child development. Individuals born with LBW are at an increased risk for heart disease, type 2 diabetes, and high blood pressure as adults (Boardman, Powers, Padilla, & Hummer, 2002). Low birthweight correlates strongly with infant mortality in North America (Berkowitz & Papiernik, 1993) and is therefore a key indicator of the reproductive health of populations in the US. This study offers insight into some of the mechanisms behind a birth outcome that can longitudinally affect a child's life in negative ways.

APPROACHES TO EXPLAINING THE HISPANIC HEALTH PARADOX

Most research on the relationship between health and socioeconomic status (SES) has consistently shown that low SES is associated with poor health outcomes. Latino immigrants represent an exception to this well-defined relationship. The Hispanic health paradox refers to a general pattern of morbidity or mortality for Latino immigrant groups that is at odds with what would be expected given their socioeconomic profile (Markides & Coreil, 1986). Thus, it is paradoxical that foreign-born Hispanics with a risk profile of sociodemographic factors conducive to adverse birth outcomes have healthier babies than native-born Hispanics, African Americans, and less advantaged whites (Franzini, Ribble, & Keddie, 2001).

Explanations for the Hispanic health paradox can be divided into five categories: 1.) the salmon bias theory; 2.) the data artifact argument; 3.) the healthy migrant theory; 4.) the assimilation argument; and, 5.) the social network argument. *Salmon bias theory* is used to explain the advantage Latino immigrants have with adult mortality. According to this theory, immigrants who are ill return home (like Pacific salmon) to die and are therefore not counted in mortality statistics in the United States (Palloni & Arias, 2004; Reichert & Massey, 1979). Overall, this argument has been used to look at adult mortality and would not make sense logically when looking at infant mortality (Hummer et al., 2007). Increasing militarization of the US/Mexico border, increased costs of migration, and decreased levels of return migration (Douglas Massey, 2009) further contribute to why a pregnant mother would not be likely to return to her home country if she expected birth complications. Thus, salmon bias is unlikely to account for paradoxical birth outcomes for Latino immigrants.

The *data artifact* argument states that paradoxical patterns might be an illusion due to an undercount of Latino deaths (Franzini et al., 2001; Palloni & Arias, 2004). Medical personnel determine ethnicity on death certificates and may misclassify Hispanics as white on death records, whereas respondents self-identify as Hispanics in the census. This incongruence between the classification of Hispanic origin in numerators by medical personnel and Hispanic self-identification in the census in denominators leads to artificially low death rates for Hispanics relative to other groups and to the appearance of an advantage (Palloni & Arias, 2004). This argument could apply to this study if the data for birth outcomes and country of origin were collected from different sources. Birth records serve as the source of data for these individual level measures in this study, so the classifications in the numerators and denominators are consistent. Therefore, this argument is unlikely to account for patterns observed in studies based wholly on birth certificates.

The next possible explanation for the Hispanic health paradox, the *healthy migrant theory,* refers to selection of immigrants. Those who emigrate are frequently the healthiest given their ability to go through the migration process (Jasso, Massey, Rosenzweig, & Smith, 2004; Palloni & Morenoff, 2001). Accordingly, these healthy migrants generally have better birth outcomes than those with poorer health who do not move. Thus, selection bias may account for better birth outcomes for immigrant women when compared to other groups (Rumbaut & Weeks, 1996).

The healthy migrant theory could vary according to nativity with health factors related to selection being more or less restrictive according to nativity and the corresponding difficulty and associated trauma of the migration process for individuals. In order to truly

test the healthy migrant theory or the selection argument, data from both origin and destination communities must be used. This study relies on geocoded birth records for a rural county where Mexico is considered a discrete country of origin by the North Carolina State Center for Health Statistics (NC SCHS) due to the size of the Mexican immigrant population. Immigrants from a variety of countries in Central/South America are grouped together by NC SCHS since immigrants from individual countries represent smaller immigrant populations and therefore have a greater need for anonymity. In this study, the effect that nativity may have on birth outcomes according to whether an immigrant is from Mexico or Central/South America may indicate varying levels of selection among immigrants in these two groups. Hence, selectivity is partially tested in this study, but is not the focus of the study given that it cannot be fully tested with these data.

This study seeks to test the *assimilation* and *social network* arguments in the Hispanic health paradox in a unique geographical context. The *assimilation argument* pertains to cultural protective factors for immigrant women that are imported from their origin countries and the fact that these factors are initially maintained. This argument states that immigrant women are more likely to live in a cultural environment with a healthy normative and behavioral context for maternity (Hayes-Bautista, 2002). This lifestyle is rooted in a social and normative context very different than in the United States and buffers or offsets disadvantaged sociodemographic conditions (Gutmann, WP Frisbie, DeTurk, & Blanchard, 1998). This environment encourages immigrant mothers to resist adopting negative risk behaviors of the host country (smoking, alcohol abuse, poor diet) (Franzini et al., 2001). Their lack of assimilation to US culture provides protection against these risk behaviors. Included in this argument is *marianismo*, which refers to women's selfless devotion to the

maternal role that is pervasive in Latin American cultures (McGlade, Saha, & Dahlstrom, 2004). Immigrants from Latin America also import strong normative attitudes pertaining to the concept of family. Marriage is preferable to singlehood, and parenthood is preferable to childlessness more so than with non-Latino whites (Oropesa, 1996). The combination of these factors creates an environment conducive to a healthy pregnancy and provides protection against adverse birth outcomes.

Assimilation is a dynamic concept that involves a change in cultural orientation and associated norms and behaviors for an immigrant over time. Ideally, assimilation should be measured by looking at change in cultural orientation and related health behaviors for an immigrant over time. Most of the literature on assimilation to US society relies on proxy measures for this concept, comparisons between foreign-born and US-born Hispanics, and scales that measure cultural orientation using cross-sectional data. Increasing time in the US is associated with increases in proportion overweight for foreign-born Latinos (Goel, McCarthy, Phillips, & Wee, 2004) and is negatively associated with reproductive health outcomes (Guendelman, English, & Chavez, 1995; Landale, Oropesa, & Gorman, 2000). Higher educational attainment among Mexican immigrants has been associated with an increase in the odds of low birthweight births (D. Acevedo-Garcia, Soobader, & Berkman, 2007). While contrary to expectation, this finding is consistent with the idea that immigrants who are the least assimilated to American culture are those with lower levels of education (Lara, Gamboa, Kahramanian, Morales, & Bautista, 2005).

Children of Mexican immigrants, or second generation Mexican Americans, do not carry the same benefit given their presumed assimilation to the host country and have less favorable birth outcomes than foreign-born Latinas (D. Acevedo-Garcia et al., 2007;

Cervantes, L. Keith, & Wyshak, 1999; Crump, Lipsky, & Mueller, 1999; Guendelman, Gould, Hudes, & Eskenazi, 1990; Pearl, Braveman, & Abrams, 2001). Diets of Hispanics born in Mexico were found to be nutritionally superior to those of US-born Hispanics and higher in calcium, folate, protein, vitamin A, and absorbic acid (Guendelman & Abrams, 1995). Alcohol use was also found to be more common among Mexican Americans than among Mexican immigrant women (Zambrana, Scrimshaw, Collins, & Dunkel-Schetter, 1997). In an examination of birth outcomes among US-born Mexican Americans and Mexican immigrants, assimilation to US culture was found to negatively affect birth outcomes through diet and smoking (Cobas, Balcazar, Benin, Keith, & Chong, 1996) and was associated with increased prenatal stress (Zambrana, Scrimshaw, Collins, & Dunkel-Schetter, 1997). Thus, immigrants benefit from the cultural behaviors they import. But, with increasing time in the US and assimilation to US culture, immigrants' imported health behaviors and practices factors diminish and seem to disappear with the second generation, implying that assimilation to US culture is bad for the health of immigrants (Rumbaut & Weeks, 1996). When taken together, this literature also illustrates the complexity of measuring the dynamic process of assimilation. Proxy measures, group comparisons, and scales are often used to ascertain assimilation to US culture as it relates to health, yet causal inference cannot be justified since most studies do not assess the cultural values of a new immigrant and follow changes in cultural orientation over time.

Assimilation of immigrants to US behavioral norms represents one aspect of assimilation relevant to health, but *spatial assimilation* represents another form of assimilation that may be salient to the health of immigrants. This study seeks to address whether living in an immigrant enclave confers additional protection against adverse birth

outcomes for Latino immigrants. Spatial assimilation theory was initially developed by the Chicago School in the 1920s where they found that immigrant residential patterns in urban areas were related to ability to learn English and increase socioeconomic status. Spatial assimilation provided a means for foreign-born city residents to move out of downtown "ghetto enclaves" to more affluent suburbs (Park, Burgess, & McKenzie, 1925). This theory was largely based on the experiences of white European immigrants before the 1970's (Hardwick, 2008) and may be contingent on historical conditions and the composition of the immigrant population at the time. Accordingly, this theory may not apply to Latino immigrants living in a different geopolitical context in the 21st century. Revised spatial assimilation theory has found that integration into mainstream white society may not enhance economic mobility, especially for nonwhite immigrants (Ellis, Wright, & Parks, 2004). This perspective is consistent with the assimilation and health literature where assimilation is disadvantageous since it is toward the status of a disadvantaged population, inferring a kind of segmented assimilation (Portes & Rumbaut, 2001). Thus, it is not clear whether spatial assimilation of immigrants into residential areas with more whites or other groups could be beneficial for immigrant groups, especially in regard to human health. Clearly, the scale and diversity of a geographic area must be incorporated into conceptualizations of spatial assimilation and settlement for immigrants in order to adequately capture the relationship between place, space, and health for this group (Entwisle, 2007).

The *social network* explanation for the Hispanic health paradox refers to the claim that the social networks surrounding immigrant women are conducive to social support that contributes to positive birth outcomes (Sherraden & Barrera, 1994) and weakens assimilation in the longer term. Insofar as migration is concerned, social networks are a "set of

interpersonal ties that connect migrants, former migrants, and non-migrants in origin and destination through ties of kinship, friendship, and shared community origin" (Massey, 1987). Social networks impact the behaviors of migrants and contribute to the decision to migrate (Korinek, Entwisle, & Jampaklay, 2005).

Social networks also provide social support that functions as a source of emotional, instrumental, and financial aid (Berkman, 1984). For immigrant women, social networks operate as informal systems of prenatal care and *personalismo* where women take responsibility for health needs of those beyond their nuclear households (Gutmann, Frisbie, DeTurk, & Blanchard, 1998). This support may mitigate the adverse effects of poverty through a pooling of resources. It may also buffer stress and improve the psychosocial space surrounding maternity. Social networks also function as mechanisms of social control where members feel pressured to behave like other network members. Norms are established within social networks concerning various health behaviors, such as smoking, alcohol use, and dietary practices (Berkman, 1984). Hence, social networks of Latino immigrant women provide a social structure for the maintenance of imported health promoting cultural norms that may decelerate assimilation to US culture. The size and density of social networks may also matter. Strong social networks can inhibit adverse health outcomes, make it easier for individuals to overcome isolation, and protect against depression (Cattell, 2001). Finally, the value of social networks and kinds of social ties in these networks depends on where an immigrant settles and how they engage (or not) with the host community, which can vary according to location type (Korinek, Entwisle, & Jampaklay, 2005).

The spatial assimilation and social network perspectives can be integrated when immigrant health and behaviors are examined in a geographic context. Residence in neighborhoods with other immigrants reduces the costs of settlement through spatially oriented networks that provide emotional and social support for recent migrants (Hagan, 1998). Residence in immigrant neighborhoods may also confer health benefits. Birthweights of children born to Mexican women were higher in predominantly Mexican immigrant neighborhoods in Chicago (Morenoff, 2003). Similar results were found in urban California (Peak & Weeks, 2002). Thus, place impacts the well-being of immigrants and may serve as a spatial context for immigrants' social networks to operate. Place may also condition the construction of these networks and therefore, their operation. Since social networks are conduits that enforce behavioral norms and may therefore delay assimilation, immigrant mothers who live closer to other immigrant mothers may have additional protection against adverse birth outcomes than those living in spatial contexts where they are ethnically isolated. This would suggest that spatial assimilation does not confer a health benefit for immigrant women. The interaction between delayed assimilation and spatially oriented social networks may provide a synergistic benefit to the health of Latina immigrants and result in additional protection against the adverse birth outcome of low birthweight. For immigrant women, it is hypothesized that living in areas characterized by higher concentrations of immigrant mothers will provide additional protection against LBW, since these women would have strong social networks of other immigrant mothers that provide normative social support and delay assimilation to risky health behaviors that contribute to the likelihood of LBW.

DATA & METHODS

This study has two purposes. The first is to examine whether the Hispanic health paradox persists in a non-traditional, rural receiving community with two immigrant populations, one from Mexico and one from Central/South America. The second purpose is to examine the impact that living in potential immigrant enclaves might have on low birthweight in a spatial context in a non-urban setting. Exploring social processes in a spatial context provides a necessary and dynamic means of conceptualizing how social forces impact health (Entwisle, 2007).

The specific setting for this research is Duplin County, a county located in the southeastern North Carolina. Duplin County grew from approximately 40,000 residents in 1990 to 53,000 residents in 2007 (US Census Bureau, 1990, 2000, 2007) with much of the growth fueled by in-migration of Latino immigrants drawn to the area by jobs in industrial agriculture (Griffith, 2010). The Hispanic origin population in Duplin County increased from 2.5% of the total population in 1990 to an estimated 20.4% of the total population in 2007 (US Census Bureau, 1990, 2000, 2005-2007). This growth illustrates how the speed and dynamics of recent migration in the southeast differs from traditional immigrant gateways (Douglas S Massey, 2010). Whereas southern cities have received the largest number of new Latino residents, rural areas have experienced greater proportional change in racial and ethnic composition (Kandel and Cromartie, 2004).

This study examines the Hispanic health paradox and low birthweight in a multidimensional context by looking at individual sociodemographic factors and risk behaviors, spatial clustering of births, and neighborhood context through logistic regression analysis. Low birthweight is specified as a dichotomous variable in this study with birthweights below 2,500 grams or 5 lbs., 8 oz. being considered LBW. This specification allows for comparability with the other studies and is a common measure for this birth outcome in both the United States and Latin America. Birth records for singleton births from 2002-2008 for mothers residing in Duplin County, NC serve as the main data source for this study (n=4,831). When compared to information in medical records, almost all North Carolina birth certificates matched the reports of birthweight in individual medical records (Buescher, Taylor, Davis, & Bowling, 1993). As indicated by Figure 1, the percentage of LBW singleton births in Duplin county from 2002-2008 is typically lower than the percentage for rural counties in North Carolina (n=29) and higher than the percentage for the United States. The percentage of LBW for singleton births in Duplin county from 2002-2008 is 7.3% and closely correlates to the state percentage of LBW during this time.

A key feature of these birth records is that they were geocoded to the residential address of mothers who reside in the study county and gave birth from 2002-2008. In other words, geographic coordinates (latitude and longitude) were assigned to residential addresses of mothers and mapped accordingly. Initially, birth records were sent to a private company that specializes in address geocoding (n=5,164). The majority of birth records for this study were matched to a street-level location representing the mother's domicile (n=3,763). However, slightly more than a quarter of the addresses (n=1,401) could only be matched to a zip code centroid or could not be geocoded at all. Of those, 393 records were subsequently

geocoded in-house to a street-level match at the mother's residential address using Juice Analytics Geocoder and ESRI Geocoder. Of the remaining records, 675 were manually geocoded using Google Earth as a guide to identify the correct location in ArcGIS, resulting in n=4,831 records. A total of 333 records had to be excluded from this study since they were not successfully geocoded to a domicile. According to a similar study that used North Carolina birth records, 93.2% of birth files with complete addresses achieved an exact block group matching using Geographic Data Technology methods in ArcGIS (Messer, Kaufman, Dole, Savitz, & Laraia, 2006). Birth records provide a considerable amount of information on sociodemographic factors and risk behaviors for individual mothers. They also provide a high degree of spatial resolution and a means to look at potential links to other mothers.

Births in this study are examined according to race, ethnicity, and nativity of the mother. Nativity data for Latino immigrants are limited on North Carolina birth records. Given the large number of immigrants from Mexico, this country is listed as a discrete country of origin. To preserve anonymity, the birth records for immigrants from countries south of Mexico in Latin America are grouped as being from Central/South America by the North Carolina State Center for Health Statistics. According to local contacts, Latina women from outside of Mexico in the study county mostly come from Honduras. This migrant stream was initially refugees due to Hurricane Mitch in 1998 with family and others subsequently migrating (Griffith, 2010). Approximately 35% of the births in this study are to immigrant women from either Mexico or Central/South America as noted in Table 1. Births to white mothers constitute 39.5% of births, while births to black mothers represent 22.7% of the study population.

This study examines whether a spatial concentration of immigrant mothers and inferred social support networks impact birth outcomes for immigrant women. Geocoded birth records provide a means to measure this construct with a high degree of spatial resolution through the creation of a birth clustering variable. Eighth-mile radial buffers surrounding each birth were selected to measure the birth clustering variable. These buffers were created around each birth in ArcGIS as noted in Figure 2. The number of same births within the eighth-mile radial buffer according to immigrant status, race, or ethnicity of other births were counted to derive the birth clustering measure for each observation. "Immigrant status" in this study refers to a mother being from Mexico or Central/South America. It does not indicate documentation or citizenship status. Eighth-mile buffers were ultimately chosen as the appropriate scale for the birth clustering variable given the geopolitical context and rural location of the study. Transportation options are limited in a rural setting and further limited for undocumented immigrants given the passage of a law limiting drivers licenses to individuals with social security cards in North Carolina (*N.C. Gen. Stat. § 20-7(b1)*, 2006). Undocumented immigrants from both Mexico and Central/South America, especially mothers, may be more likely to stay closer to their domicile given this context. Other buffer sizes were explored before eighth-mile radial buffers were selected. Half-mile and then quarter-mile radial buffers were examined, but resulted in wide and highly variable distributions of births according to nativity, race, or ethnicity (See Appendix A, Tables A.1 and A.2). They also resulted in a smaller sample size since buffers that went over the county boundary were excluded from the study due to edge effects. For a rural county, these buffer sizes also appeared too large to capture a neighborhood when examined spatially in ArcGIS.

Using geocoded birth records to measure a residential co-ethnic concentration for a study focused on birth outcomes in a rural county is preferred to the alternative of relying on US Census data. With birth records, the creation of a same ethnicity[2] birth clustering variable provides an individual measurement of local co-ethnic concentration and inferred local social support networks within a consistent area for each birth (n=4,831). Using Census data would result in measurements representing the 38 block groups applied to the study population and arbitrary and varying boundaries of what is considered local for each birth. Thus, the specificity of the co-ethnic concentration measure is better through using geocoded birth records.

The main benefit of using US Census data to measure co-ethnic concentration is that this data source captures information on everyone (all ages, men as well as women) and not just mothers as is the case with geocoded birth data. This difference brings to question who should be counted when thinking about social support networks for immigrant mothers. Latin American gender ideology emphasizes the maternal role for women, while men, especially those who migrate, have a largely economic role (Hondagneu-Sotelo, 1994). Accordingly, the gender composition of social networks has been shown to be an important lens for examining various aspects of immigrant women's well-being (Parrado, Flippen, & McQuiston, 2005). Since mothers are the people who talk about babies and pregnancy, they are the right group to target when measuring co-ethnic concentration and emphasize why birth records are preferred over Census data.

The timing and extent of data collection for the US Census further highlight why geocoded birth records represent a superior means to measure co-ethnic concentration for a rural county. The most recent Census data for Duplin County are from 2000, while the birth

[2] In some instances, "ethnicity" and "co-ethnic" pertains to race, nativity, and nativity.

records range from 2002-2008. Given the dynamics of demographic change in the study county, data from 2000 seem increasingly distant for a county that is quickly changing. Nativity data for Hispanics were collected at the tract level in the 2000 Census data for Duplin County and only represent eight tracts. While tracts may be appropriate for measuring neighborhoods in urban contexts, they are insufficient for measuring neighborhoods in a rural county with an area of approximately 800 square miles. This distinction is important since one of the main thrusts of the Hispanic health paradox is based on nativity and how health behaviors and birth outcomes vary by nativity. In this study, census data will be considered to ensure that the results do not significantly differ in any major way from those found using geocoded birth records to measure co-ethnic concentration.

Sociodemographic factors and risk behaviors are key variables when examining the Hispanic health paradox since Latino immigrant women have better birth outcomes despite low SES and limited access to prenatal care. They are also less likely to engage in the risky health behavior of smoking given their lack of assimilation to US culture. Birth records provide data on established *sociodemographic factors* that impact birth outcomes, including maternal age, education, marital status, and parity (Braveman, Cubbin, Marchi, Egerter, & Chavez, 2001; Martin et al., 2007). Birth records also provide data on individual level *risk behaviors* that impact birth outcomes, including initiation of prenatal care and tobacco use during pregnancy (Fiscella, 1995; US Surgeon General, 2004).

Table 2 illustrates descriptive results for the study population. According to Table 2, births to immigrant mothers from Mexico and Central/South America represent the lowest proportion of low birthweight births among groups in the study at 4.4% and 5.0%,

respectively. Immigrant mothers have lower levels of education and higher parity than women in other groups, reflecting fertility trends in this population in North Carolina. They are also less likely to be married than whites and less likely to initiate care in the first trimester than other groups. Of all groups, Latino immigrant women have the lowest levels of reported tobacco use during pregnancy. Less than 1% of immigrant women smoked during pregnancy while 20% of births to white women had mothers who reported tobacco use during pregnancy. Despite a risk profile with lower levels of education, later initiation of prenatal care, and lower likelihood of being married, immigrant women have better birth outcomes than white women. They are also less likely to smoke during pregnancy than other groups. These findings are consistent with a paradox that will be examined in Table 3 in a multivariate way.

RESULTS

The first goal of this study is to examine whether the Hispanic health paradox persists in a new, non-traditional receiving community and whether birth outcomes vary for immigrants from Mexico and from Central/South America through logistic regression analysis. The second goal of this study is to test whether a spatial clustering of births may provide additional protection against LBW or explain some of the effect that immigrant status and other variables have on LBW.

Results in Table 3 are shown as a series of logit regression models where the dependent variable is the log odds of low birthweight. The first five models address the existence of the Hispanic health paradox. The second part of the analysis focuses on how the birth clustering variable and implied co-ethnic concentration may impact birth outcomes in Models 6-11 in Table 3. The study population is divided by race and ethnicity in Model 1. Relative to whites, Hispanics have a lower and blacks have a higher log odds of LBW. Given that 92.9% of the Hispanic births in the study population are to Latino immigrant mothers, measures of race and ethnicity do not sufficiently characterize the diversity of mothers considered Hispanic in this study. In the Hispanic health paradox, nativity is what distinguishes birth outcomes for Hispanic women. Immigrant Hispanic women are less likely to have adverse birth outcomes than US-born Latinas given their lack of assimilation to US culture, imported cultural norms regarding maternity, and social support networks. When Hispanic ethnicity is separated according to nativity in Model 2, immigrant women

from Mexico and Central/South America have a .47 and .33 lower log odds of LBW than whites, respectively. A t-test revealed that the difference between these coefficients was not significant, resulting in immigrants from Mexico and Central/South America being grouped together in Model 3. This finding indicates that the effect of nativity does not significantly vary by country of origin.

There appears to be no difference between US-born Hispanics and whites in Model 3 and across all models. US-born Hispanics are kept as a distinct group since these women are US citizens who did not import cultural norms regarding maternity from abroad and have higher levels of assimilation to US culture. Accordingly, they have a different social context than immigrant women. Grouping native and non-native Hispanics would not make logical sense given the theoretical focus of this study and differing levels of assimilation for these groups.

The sociodemographic factors of mother's age, education, marital status, and parity have established relationships to birth outcomes (D. Acevedo-Garcia et al., 2007; Martin et al., 2007). They are added to Model 4 since some of these factors, such as marital status and education, are implicated in the Hispanic health paradox since they are considered indicators of SES. In Model 4, the coefficient for immigrant increases to -.635 as the covariates of being married and parity are shown to negatively impact the log odds of LBW. Controlling for sociodemographic factors in Model 4 indicates how the net effect of immigrant status strengthens while the effect of black race weakens with the addition of these covariates.

The risk behaviors of prenatal care and smoking during pregnancy are added to Model 5. When these factors are added, the coefficient for immigrant status weakens to -.363. "No prenatal care" has a coefficient of .767 in this model, indicating that having

prenatal care is better than having no care. Thus, prenatal care matters, but whether or not it is initiated is what matters. Only 2% of all groups in this study had no prenatal care, therefore interpretation of this coefficient must be done cautiously. The advantage Hispanic immigrant status confers would be less if Hispanic immigrant mothers smoked like whites, the group to most likely to smoke in this study. Less than .5% of Latino immigrant mothers smoked during pregnancy in this study, while 20.2% of births to whites were to mothers who smoked while pregnant. Accordingly, smoking mediates the relationship that immigrant status has to LBW relative to whites in this study. The risk behavior of smoking during pregnancy partially explains the Latino immigrant/white difference.

Contrasting how sociodemographic factors and risk behaviors impact the net effect of black race and immigrant status on LBW highlight the existence of the Hispanic health paradox in this study. In Model 4, controlling for sociodemographic factors strengthens the negative effect of immigrant status on the log odds of LBW, relative to whites. On the other hand, controlling for sociodemographic factors attentuates the effect of black race on LBW, relative to whites. Including sociodemographic factors in the model explains some of the difference between blacks and whites in this study, yet exacerabates the difference between immigrants and whites. When risk factors are added in Model 5, the net effect of black race strengthens and the net effect of immigrant status weakens, relative to whites. When covariates are added where blacks and Hispanic immigrants are advantaged in comparison to whites, the net effect of immigrant status is attentuated. The opposite occurs with the effect of black race in Model 5. The addition of risk factors emphasize how the risky behavior of smoking during pregnancy explains some of the advantage conferred by immigrant status and the immigrant/white difference.

The second half of the regression analysis focuses on the role of implied co-ethnic residential concentration measured by a clustering of births according to immigrant status, race, or ethnicity. This variable is continous and measures the number of same births according to group. Local variance in number of same births according to group was found and is illustrated in Tables 4 and 5 in Appendix C. On average, immigrants have a higher number of other immigrant mothers nearby when compared to other groups.

The birth clustering variable is added to Model 6 to see if co-ethnic residential concentration implied with this variable impacts the log odds of LBW for minorities relative to whites. Somewhat surprisingly, no effect is found after testing multiple buffer sizes (see Tables 6 and 7 in Appendix C) or across models in this part of the study. The assumption with this measure was that the effect would be stronger for immigrant women since immigrant enclaves may serve as a geographic context conducive to informal systems of prenatal care as implicated in the Hispanic health paradox. In Model 7, the birth clustering variable is differed according to group, and no effect is found. Risk factors are added to Model 8 with the expectation that social support for immigrant women would weaken the effect of risk factors due to a normative environment conducive to a healthy pregancy. Again, no effect is found. Sociodemographic factors are added to Model 9 with the expectation that nearby social support networks may mitigate the effects of SES found to be significant in earlier models, and no effect is found.

In Model 10, Census variables are used in place of clustering to examine if clustering was the wrong variable to use to measure local co-ethnic concentration. The results show that the neigbhorhood context variables used have no effect. Co-ethnic concentration was also examined using 2000 Census block group data, resulted in no effect, and was taken out

of the model. Finally, neigbhorhood context and birth clustering are both examined in Model 11 to see if birth clustering is correlated to neighborhood context and resulted in no significant effects for either set of variables.

Despite a lack of effect in the regression results, local variance for the birth clustering variable was found and shows how mothers in this rural county are living in different environments. Table 5 in Appendix C illustrates the mean number of same births according to immigrant status, race, or ethnicity. On average, there are 8.65 other immigrant births within a eighth-mile radial buffer of a birth to an immigrant mother. That indicates that there could be eight other mothers living within an eighth-mile radius of an immigrant mother. Mexicans and Central/South Americans are grouped together as immigrants since the difference between the coefficients for nativity was not significant in first part of the analysis. Accordingly, birth clusters for these immigrants include births to mothers from both Mexico and Central/South America. Births to black women, on average, have five other births to black mothers nearby. While the regression results provide no clear indication of how birth clustering affect low birthweight, the descriptive tables illustrate how the local context of births varies according to group in this rural county. Lack of variance is not the explanation for a lack of effect of this variable.

IMPLICATIONS

This study provides evidence that the Hispanic health paradox persists in a context not characterized by previous studies. Despite lower levels of education, prenatal care, and marriage, Latino immigrant women in a rural county in a new receiving state have healthier babies than other minority groups and notably whites in this study. Mothers from both Mexico and Central/South America have healthier babies in a county characterized by a rapid pace of in-migration during a geopolitical era where immigrants' rights and mobility are limited. Smoking during pregnancy explained some of the protection against LBW that immigrant status provides relative to whites in a rural area of a state with a historically strong tobacco industry.

Latino immigrants in this study have a 33% lower odds of having a LBW baby than whites (not reported in the tables). This finding is similar to results found using birth records for Chicago where Mexican immigrants had a 22% decreased odds of LBW relative to US-born whites (Cervantes, Keith, & Wyshak, 1999). However, this finding is unique among the literature on the Hispanic health paradox and low birthweight since most studies do not find that Latino immigrant women have a lower odds of LBW than white women. The comparison group for Latino immigrant women is often US-born Latinas. A national study using US Natality Detail Data found that foreign born status decreased the odds of LBW by 21% for Mexican origin women relative to US-born Mexican origin women (Acevedo-Garcia, Soobader, & Berkman, 2007). These comparisons highlight the difference between

this study and the existing literature on the Hispanic health paradox and birth outcomes. Most of these studies focus on an urban area that is oftentimes a traditional immigrant gateway city or use aggregated data for a large geographic area. This study may be the first to reveal that the Hispanic health paradox exists in a rural county in the southeast that is a new immigrant destination and that birth outcomes for Latino immigrants are superior to those of whites.

The impact of immigrant status is noteworthy since it includes immigrants from Mexico and from Central/South America, a group where consistent results regarding low birthweight are not well established in the literature. Risk of low birthweight does not vary by much (less than one percentage point) for immigrants from Mexico and Central/South America (Table 2), and the effect of nativity on LBW for women from Mexico or Central/South America is not significantly different. According to these findings, it does not appear that migrants from Mexico or Central/South America have different levels of baseline health and therefore different selection gradients that may impact birth outcomes.

The assimilation argument in the Hispanic health paradox receives support in this study. Lower levels of education and marriage for immigrants in this study may indicate a lack of assimilation to US culture and institutions. At the same time, controlling for marriage may mean two different things for blacks and Latino immigrants. Immigrant couples who come to the United States and have children together may not be technically married in the US, but there is the presence of a male partner for the mother. On the other hand, black women who are not married may be more likely to be single mothers, thus being married may not be measuring the same thing for these two populations. The assimilation argument receives further support in the regression analysis where smoking mediates the relationship

that immigrant status has to LBW, relative to whites. This model also offers the most explanatory power of all of the models used in this study. This finding is consistent with other studies where assimilation to US culture was found to negatively impact birth outcomes through smoking (Cobas, Balcazar, Benin, V. M. Keith, & Chong, 1996; Wolff & Portis, 1996).

While these findings contribute to the literature on the assimilation aspect of the Hispanic health paradox, they bring to question how assimilation may differ among groups. Most of the literature on assimilation and health is based on Mexican immigrants and not on Central/South American immigrants. The risk profiles for Mexican and Central/South Americans were almost identical, but it is not clear whether the mechanisms behind the these groups may be different. Do imported cultural norms related to maternal and child health vary in some way according to origin community? Do Mexican and Central/South Americans assimilate to risky health behaviors in a similar fashion? Assimilation has been found to vary according to nativity (Alba & Nee, 1997; Chun, 2003), but it is not clear whether assimilation to risky health behaviors is the same across these groups, especially given the lack of data on migration history, origin community, and time in the US in this study.

Measuring co-ethnic residential concentration and inferred local social support networks for immigrant women in a rural area and new immigrant destination area proves to be a challenge in this study. The birth clustering variable was perceived as a good way to look at local social support networks in a rural context. This measure appeared better than the alternative of relying on dated Census data with artificial boundaries and less individual level data. The birth clustering variable was measured by creating radial buffers surrounding

each birth and counting the number of same births according to immigrant status, race, or ethnicity. Numerous adaptions of this measure were examined using different buffer sizes and different ways of enumerating co-ethnic residential concentration (See Appendix C). Initially, all three Hispanic subgroups (Mexicans, Central/South Americans, US-born Hispanics) were looked at separately. This measure was then specified by grouping Latino immigrants together and then all Hispanics together, and none of the specifications of this variable resulted in significant effects. Birth buffers that went outside of the study county were excluded from the analysis and are indicated by the varying sample sizes according to the size of the radial buffer in Tables 4 and 5 (half-mile, quarter-mile, eighth-mile). Hence, edge effects contribute to the difficulty of this measure to sufficiently capture the social environment of mothers in the study county. The birth clustering variable used in this study is an indirect measure of social support networks. It was created with the assumption that mothers living close to each other know and interact with each other. These assumed patterns of interaction may or may not explain how social networks and social support from other mothers operate for immigrant mothers and other groups. These assumptions may be incorrect, especially since mobility of mothers in this study could not be ascertained. The birth clustering measure illustrated variability among groups, but some of this variability could be related to fertility differences between groups. The exclusion of immigrant mothers in the study area who did not give birth in the study period and the inference that each birth represents a separate mother with the birth clustering variable could contribute to the lack of effect of this measure on LBW.

The geographic context of the study may also contribute to why social environment effects were not found. This study represents a case study of a rural county in the southeast.

Variability is constrained by the location. Given how small and specific this area is, there is a limited likelihood of finding an effect for local social support networks. More variation would be found by looking at a larger geographic area or across the state. Local social support for immigrants was examined by looking at the number of immigrant births nearby. Given the rough measure of time in the study county assessed through Census data, a lower level of assimilation was assumed. Ideally, one would want to look at groups over time and when individuals moved to a place to better test spatial assimilation and the role of spatially oriented social support networks on health.

This examination into the Hispanic health paradox in Duplin County using geocoded birth records from 2002-2008 represents a cross-sectional study, a snapshot of a time and a place. Assimilation and the formation of social networks and social ties in a location are processes that occur over time. Thus, the process used in this study does not match the theory being tested. This study examines inferred social support networks for immigrants by using a birth clustering measure at a moment in time with the asumption that social support networks have already been established. Clearly, work incorporating both temporal and spatial dimensions needs to be done to better measure assimilation and social network formation. Spatially oriented social support for mothers may vary according to group and impact birth outcomes, but no effect is found in this study. Thus, it is premature to conclude that it does not exist even though it was not found in this study.

Limitations to this study consist of omitted variables and measurement issues associated with using birth records. While it assumed that mothers from Mexico and Central/South America are less assimilated to the US than Hispanic mothers native to the US, this study has no way of ascertaining how long these immigrant mothers have lived in the

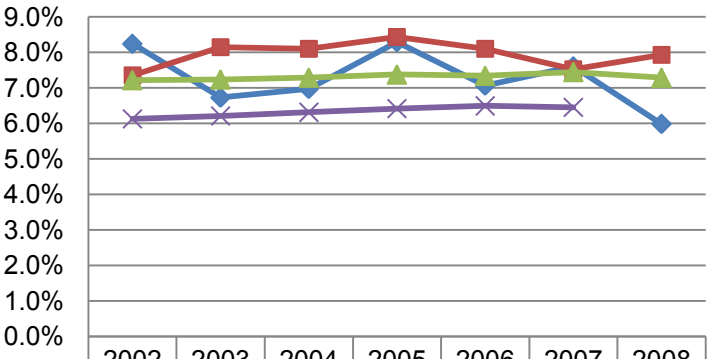
United States and their cultural orientations when they arrived. It is relatively easy to limit their time in the study area due to Census data, but it is not clear where these women lived prior to their residence in the study area. Alcohol use is another omitted variable that is salient in birth outcome research and relevant to the assimilation argument of the Hispanic health paradox. Alcohol use during pregnancy has a clear relationship to adverse birth outcomes (Olegard et al., 1979), yet this health behavior is underreported in both medical records and birth certificates and is therefore unreliable (Buescher et al., 1993). How nativity is captured on birth records represents another limitation to this study. Local contacts, 2000 Census data, and research relying on fieldwork were used to illustrate that the mothers listed as "Central/South American" were predominantly from Honduras during the study period. When examining social support that is based on imported cultural norms, one would ideally want to look at origin communities in Mexico and countries of origin in Central/South America. Religion, ethnicity, and skin color represent just a few of the differences among Latino immigrants from various origin communities in Latin America and highlight cultural differences that may impact the social environment for migrants from these communities in the US. How groups settle in the study county and form social support networks may also vary according to their origin community.

This study reveals that the Hispanic health paradox persists in a rural area in a new receiving state for migrants from Mexico and Central/South America. Support for the assimilation argument is found, but it is not clear if local co-ethnic social support impacts birth outcomes for immigrant women in this study. Conceptualizing the social environment surrounding maternity for immigrant women proves to be a challenge in a rural area. Approaches that may work in urban contexts do not transfer well to rural settings and raise a

number of questions. What does it mean to look at neighborhood effects in a rural environment? And, how would that be different for new immigrant populations during a political era where anti-immigrant sentiment is high? Creative approaches are needed to measure the social environment for immigrant women and how it may relate to health in rural areas in this new era of immigration. Latino immigrants in a non-traditional context continue to have superior birth outcomes, but how to sufficiently measure the social environment for immigrant mothers warrants further attention.

APPENDIX A: FIGURES

Figure 1
Percentage Low Birthweight Singleton Births, 2002-2008



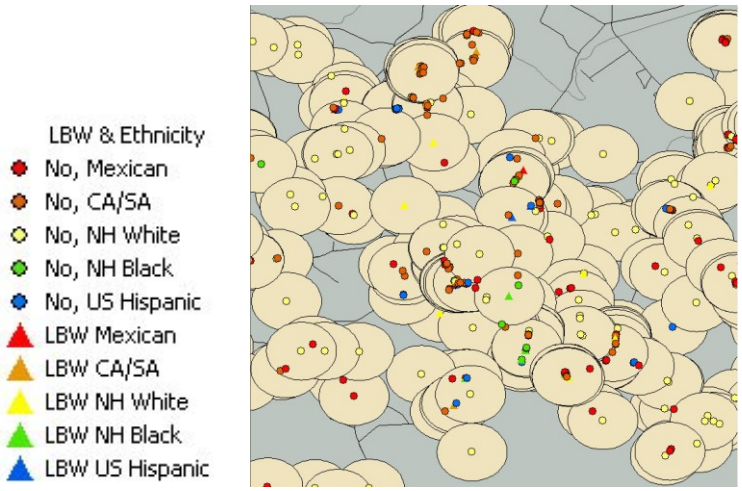
	2002	2003	2004	2005	2006	2007	2008
Duplin County	8.2%	6.7%	7.0%	8.3%	7.1%	7.6%	6.0%
Rural Counties (NC)	7.3%	8.1%	8.1%	8.4%	8.1%	7.5%	7.9%
North Carolina	7.2%	7.2%	7.3%	7.4%	7.3%	7.4%	7.3%
United States	6.1%	6.2%	6.3%	6.4%	6.5%	6.5%	

SOURCES: Duplin County, rural North Carolina counties, and North Carolina singleton low birthweight percentages were calculated using North Carolina State Center for Health Statistics live birth data (http://www.epi.state.nc.us/SCHS/data/births/bd.cfm).

Rural classification for counties was established by using core based statistical area classifications according to the US Census Bureau and Office of Management and Budget (November 2005).

US singleton low birthweight rates were calculated using National Center for Health Statistics Vital Statistics data (http://www.cdc.gov/nchs/vitalstats.htm). Data for 2008 were not yet available.

Figure 2
Eighth-mile Radial Birth Buffers



The radial buffers created in ArcGIS illustrate the composition of births surrounding individual births and serve as proxies for neighborhoods surrounding individual mothers. The number of same births within the buffer according to ethnicity are counted within each birth buffer and assigned as the birth clustering variable measure for each birth. This measures implied co-ethnic residential concentration.

APPENDIX B: TABLES

Table 1: Race, Ethnicity, and Nativity of Singleton Birth Sample, Duplin County 2002-2008 (n=4,831)

Race/Ethnicity	% of sample	n
White	39.5%	1,907
Black	22.7%	1,099
Hispanic	37.8%	1,825
		4,831

Nativity for Hispanic	% of Hispanic subgroup	n
Mexico	48.9%	893
Central/South America	44.0%	803
US-born Hispanic	7.1%	129
		1,825

Race/Ethnicity/Immigrant Status	% of sample	n
White	39.5%	1,907
Black	22.7%	1,099
US-born Hispanic	2.7%	129
Immigrant**	35.1%	1,696
		4,831

** *Immigrant* indicates a birth to a mother from either Mexico or Central/South America.

Table 2: Descriptive Statistics of Singleton Birth Sample, Duplin County 2002-2008

Mean (SD)	Mexican (n=893)	Central/South American (n=804)	US-Born Hispanic (n=129)	Black (n=1,099)	White (n=1,907)	Total (n=4,831)
Low Birthweight, %	4.4%	5.0%	8.5%	12.0%	6.8%	7.3%
Sociodemographic Factors						
Age	26.0 (5.9)	26.2 (5.7)	21.3 (5.2)	23.9 (5.6)	26.2 (5.7)	25.5 (5.8)
Years of Education	7.9 (3.1)	7.2 (3.9)	9.9 (2.2)	12.1 (1.8)	12.9 (2.3)	10.8 (3.6)
Married, %	46.4%	31.4%	43.4%	24.5%	71.8%	48.9%
Parity	1.42 (1.36)	1.49 (1.38)	0.85 (1.01)	1.02 (1.17)	0.89 (1.06)	1.12 (1.23)
Risk Behaviors, %						
Initiation of Prenatal Care						
No Prenatal Care	0.7%	1.5%	0.0%	1.1%	0.6%	0.9%
1st Trimester	72%	66%	76%	78%	89%	79%
2nd Trimester	23%	28%	22%	19%	9%	18%
3rd Trimester	4%	4%	2%	2%	1%	2%
Smoked during Pregnancy	0.2%	0.1%	2.3%	7.3%	20.2%	9.8%

Table 3: Logistic Regression Results for Low Birthweight (LBW), Duplin County 2002-2008

Model	1	2	3	4	5	6	7	8	9	10	11
Race/Ethnicity											
White											
Black	0.624***	0.624***	0.624***	0.496***	0.655***	0.647***	0.665***	0.768***	0.696***	0.654***	0.704***
	(0.130)	(0.130)	(0.130)	(0.143)	(0.149)	(0.133)	(0.157)	(0.162)	(0.172)	(0.153)	(0.174)
Hispanic	-0.344**										
	(0.141)										
Nativity for Hispanic											
Mexican		-0.471**									
		(0.187)									
Central/South American (CA/SA)		-0.333*									
		(0.186)									
US-born Hispanic		0.242	0.242	0.136	0.348	0.245	0.147	0.284	0.261	0.334	0.218
		(0.328)	(0.328)	(0.337)	(0.342)	(0.328)	(0.403)	(0.406)	(0.412)	(0.343)	(0.414)
Immigrant Status†											
Immigrant (Mex or CA/SA)††			-0.404***	-0.635***	-0.363*	-0.374**	-0.327*	-0.173	-0.277	-0.389*	-0.298
			(0.147)	(0.198)	(0.210)	(0.151)	(0.193)	(0.202)	(0.240)	(0.212)	(0.242)
Birth Clustering†††											
Same Ethnicity Birth - 1/8 mile radial buffer						-0.008	0.001	-0.000	0.002		-0.001
						(0.010)	(0.028)	(0.028)	(0.029)		(0.028)
Same Eth Births x Immigrant							-0.009	-0.009	-0.012		-0.013
							(0.025)	(0.025)	(0.025)		(0.025)
Same Eth Births x Black							-0.009	-0.008	-0.010		-0.012
							(0.032)	(0.032)	(0.032)		(0.032)
Same Eth Births x US Hispanic							0.037	0.044	0.032		0.038
							(0.087)	(0.087)	(0.087)		(0.087)
Sociodemographic Factors											
Mother's Age in Years				0.020	0.018				0.018	0.019	0.019
				(0.012)	(0.012)				(0.012)	(0.012)	(0.012)
Mother's Education in Years				-0.032	-0.020				-0.020	-0.020	-0.021
				(0.025)	(0.025)				(0.025)	(0.025)	(0.025)
Married				-0.346**	-0.249*				-0.254*	-0.245*	-0.250*
				(0.135)	(0.136)				(0.136)	(0.136)	(0.136)
Parity				-0.110*	-0.139**				-0.137**	-0.139**	-0.137**
				(0.059)	(0.060)				(0.060)	(0.060)	(0.060)
Risk Behaviors											
No Prenatal Care					0.767*			0.729	0.761*	0.771*	0.770*
					(0.458)			(0.454)	(0.458)	(0.459)	(0.459)
lst Trimester Care											
2nd Trimester Care					0.198			0.208	0.200	0.194	0.196
					(0.147)			(0.144)	(0.147)	(0.147)	(0.147)
3rd Trimester Care					0.094			0.084	0.099	0.090	0.092
					(0.380)			(0.378)	(0.380)	(0.379)	(0.380)
Smoking during Pregnancy					0.734***			0.759***	0.733***	0.736***	0.735***
					(0.165)			(0.161)	(0.165)	(0.165)	(0.165)
Neighborhood Context											
Home Ownership %										-0.569	-0.791
										(0.712)	(0.730)
% below Poverty Line										-0.314	-0.243
										(1.128)	(1.136)
Constant	-2.615***	-2.615***	-2.615***	-2.377***	-2.770***	-2.600***	-2.616***	-2.842***	-2.759***	-2.304***	-2.134***
	(0.091)	(0.091)	(0.091)	(0.358)	(0.372)	(0.093)	(0.107)	(0.121)	(0.377)	(0.772)	(0.785)
Observations	4,831	4,831	4,831	4,831	4,831	4,831	4,831	4,831	4,831	4,831	4,831

Robust standard errors in parentheses (* p<0.05, ** p<0.01, *** p<0.001)

Notes:

†*Immigrant Status* indicates whether or not a mother is foreign-born. It does not indicate documentation status.

†† Immigrants from Mexico and Central/South America were grouped together since the difference between the coefficients for these two groups was insignificant (t=.5988, Pr(|T| > |t|) = 0.5494).

††† Same ethnicity births for immigrants include births to immigrants from Mexico and Central/South America.

†††† Dummy variables for years were added into the models, found to be insignificant, and removed.

Goodness of Fit Measures

Likelihood Ratio Test for Nested Models

	Model 3	Model 4	Model3		Model 6	Model 7	Model 8	Model 10	Model 5
LR Statistic	12.3	22.26	34.57		0.44	24.84	9.88	2.03	2.83
Prob > chi2	0.0152	0.0002	0.00001		0.9319	0.0001	0.0426	0.7308	0.8301
Nested in	Model 4	Model 5	Model 5		Model 7	Model 8	Model 9	Model 11	Model 11

** Likelihood Ratio Test results reveal that the addition of sociodemographic factors and risk behaviors improve the goodness of fit of the models (Models 4, 5, 8, & 9). The addition of clustering (Model 6) and neighborhood context (Model 10) do not improve the overall model. Clustering and neighborhood context are also not significant in affecting probability of LBW. A likelihood ratio test was also performed to see if clustering (Model 11) would improve the neigbhorhood context model (Model 10) and was not found to do so.

APPENDIX C: BIRTH CLUSTERING ANALYSIS

Table 4: Number of Same Births according to Nativity, Race or Ethnicity, & Radial Buffer Size

	1/8 mile	1/4 mile	1/2 mile
Mexican	4.72	6.35	12.69
	(4.80)	(0.84)	(11.86)
CA/SA	7.44	11.02	25.23
	(9.99)	(17.62)	(30.74)
White	1.98	3.69	9.75
	(2.23)	(4.78)	(12.71)
Black	5.08	6.52	14.85
	(0.99)	(8.88)	(15.07)
US Hispanic	2.35	1.89	4.15
	(3.46)	(3.70)	(4.51)
OVERALL	4.08	5.96	13.79
	(6.14)	(9.76)	(18.01)

Table 5: Number of Immigrant Births according to Radial Buffer Size

	1/8 mile	1/4 mile	1/2 mile
Immigrant	8.65	13.38	28.87
	(9.45)	(17.30)	(30.27)
By Immigrant Subgroup			
Mexican	7.27	11.07	22.57
	(7.19)	(13.43)	(23.21)
CA/SA	10.19	16.06	36.19
	(11.23)	(20.60)	(35.46)

Table 6: Logistic Regression Results on Low Birthweight by Number of Same Ethnicity Births

Model	1	2	3	4	5	6
Spatial Variables						
Same Ethnicity Births in 1/2 Mile Buffer	-0.004	0.001				
	(0.003)	(0.007)				
Same Eth Births x Black		-0.009				
		(0.010)				
*Same Eth Births x Immigrant**		-0.002				
		(0.008)				
Same Eth Births x US Hispanic		0.036				
		(0.064)				
Same Ethnicity Births in 1/4 Mile Buffer			-0.007	-0.028		
			(0.006)	(0.022)		
Same Eth Births x Black				0.032		
				(0.024)		
Same Eth Births x Immigrant				0.018		
				(0.023)		
Same Eth Births x US Hispanic				0.101		
				(0.070)		
Same Ethnicity Births in 1/8 Mile Buffer					-0.008	0.009
					(0.010)	(0.040)
Same Eth Births x Black						-0.017
						(0.043)
Same Eth Births x Immigrant						-0.020
						(0.042)
Same Eth Births x US Hispanic						0.030
						(0.091)
Race, Ethnicity, and Nativity						
White						
Black		0.762***		0.514***		0.691***
		(0.173)		(0.162)		(0.167)
Immigrant (Mex or CA/SA)		-0.377*		-0.377**		-0.300
		(0.198)		(0.186)		(0.199)
US-born Hispanic		0.097		-0.017		0.172
		(0.456)		(0.387)		(0.407)
Constant	-2.501***	-2.637***	-2.507***	-2.528***	-2.517***	-2.642***
	(0.070)	(0.115)	(0.065)	(0.114)	(0.067)	(0.122)
Observations	4,582	4,582	4,752	4,752	4,831	4,831

Robust standard errors in parentheses (* p<0.05, ** p<0.01, *** p<0.001)

* Same ethnicity births for immigrants include births to immigrants from Mexico and Central/South America.

Table 7: Logistic Regression Results on Low Birthweight by Number of Same Ethnicity Births with Immigrant Groups Separated

Model	1	2	3	4	5	6
Spatial Variables						
Same Ethnicity Births in 1/2 Mile Buffer	-0.004	0.001				
	(0.003)	(0.007)				
Same Eth Births x Mexican		0.009				
		(0.015)				
Same Eth Births x CA/SA		-0.005				
		(0.009)				
Same Eth Births x Black		-0.009				
		(0.010)				
Same Eth Births x US Hispanic		0.036				
		(0.064)				
Same Ethnicity Births in 1/4 Mile Buffer			-0.007	-0.028		
			(0.006)	(0.022)		
Same Eth Births x Mexican				-0.002		
				(0.033)		
Same Eth Births x CA/SA				0.023		
				(0.024)		
Same Eth Births x Black				0.032		
				(0.024)		
Same Eth Births x US Hispanic				0.101		
				(0.070)		
Same Ethnicity Births in 1/8 Mile Buffer					-0.008	0.009
					(0.010)	(0.040)
Same Eth Births x Mexican						-0.023
						(0.053)
Same Eth Births x CA/SA						-0.019
						(0.045)
Same Eth Births x Black						-0.017
						(0.043)
Same Eth Births x US Hispanic						0.030
						(0.091)
Race, Ethnicity, and Nativity						
Mexican		-0.567**		-0.369		-0.360
		(0.270)		(0.232)		(0.255)
Central/South American (CA/SA)		-0.256		-0.408*		-0.273
		(0.244)		(0.228)		(0.244)
Black		0.762***		0.514***		0.691***
		(0.173)		(0.162)		(0.167)
US-born Hispanic		0.097		-0.017		0.172
		(0.456)		(0.387)		(0.407)
Constant	-2.501***	-2.637***	-2.507***	-2.528***	-2.517***	-2.642***
	(0.070)	(0.115)	(0.065)	(0.114)	(0.067)	(0.122)
Observations	4,582	4,582	4,752	4,752	4,831	4,831

Robust standard errors in parentheses (* p<0.05, ** p<0.01, *** p<0.001)

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