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## Using Geographical Information Systems to Explore Disparities in Preterm Birth Rates Among Foreign-born and U.S.-born Black Mothers

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### Abstract

**Objective**—To examine spatial patterns of neighborhood contextual factors of stress with preterm birth (PTB) and nativity (foreign-born and U.S.-born) among Black mothers.

**Design**—Descriptive geographic-spatial research.

**Setting & Participants**—Births to Philadelphia residents during 2003–2005 in the context of Philadelphia residential neighborhoods ( $N = 350$ ) were studied.

**Methods**—All data were aggregated to neighborhood levels (census tracts). Maps were created to assess geographic-spatial patterns. A geographic information system (GIS) database was created that imported geo-coded data on births, crime (assaults with guns and domestic abuse), poverty, race, and nativity (foreign-born vs. U.S.-born).

**Results**—Clear visual patterns of “bad” neighborhoods emerged and were significantly associated with higher prevalence of PTB for foreign-born Black and U.S.-born Black mothers ( $p < .0001$ ).

**Conclusions**—This study demonstrated how GIS visually clarified important spatial patterns of adverse living conditions and PTB prevalence. Nurses can use GIS to better understand living environments of mothers and their families and to target interventions in geographical areas with the greatest service needs. Further research on individual and contextual factors is warranted to address the observed health disparities among the heterogeneous groups of foreign-born Black mothers. Despite limitations of aggregate data, it is clear that where mothers live matters. This has important implications for nursing practice and policy.

### Keywords

preterm birth; urban population; poverty; violence; racial/ethnic health disparities; nativity; social environment; GIS

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The United States continues to be a place where foreign-born Black women migrate, and variation exists in the preterm birth (PTB) rate among Black women based on country of birth. In the United States, national vital records for 2003 indicated a PTB rate for foreign-born Black women as 13.9% compared to 18.2% for U.S.-born Black women (Martin, Kochanek, Strobino, Guyer, & MacDorman, 2005). Despite a plethora of literature aimed at exploring factors contributing to the PTB rate differential between White and Black women,

there is a dearth of literature directed toward the observed PTB rate differential between foreign-born Black and U.S.-born Black women. Also unexamined is the impact of country of birth, reason for immigration, and duration of residency in the United States on the reproductive outcomes of foreign-born Black women. Specifically, the underpinnings of the observed protective effect of foreign-born nativity on rates of adverse birth outcomes among Black women have been understudied.

Drawing from evidence accumulated through the study of the seemingly paradoxical perinatal outcomes of Mexican-born versus U.S.-born Mexican women, the findings suggest that complex acculturation effects erode the health status of immigrant groups. The paradox is that despite being poorer and having less education, Mexican-born mothers have better birth outcomes than U.S.-born Mexican mothers. However, as the duration of tenure increases, the rate of low birth weight and PTB also increases (Collins, David, Mendivil, & Wu, 2006; Ruiz et al., 2008; Zambrana, Dunkel-Schetter, Collins, & Scrimshaw, 1999). Examining nativity among Black mothers is an important focus for health disparities research.

Where you live can affect your health and has been shown to be associated with PTB (Collins & Schulte, 2003; Culhane, Rauh, McCollum, Elo, & Hogan, 2002; Holzman et al., 2009; Messer, Kaufman, Dole, Savitz, & Laraia, 2006; O'Campo et al., 2008). Living in an impoverished neighborhood creates material hardships and socioeconomic disadvantage (Massey, 2009). Living in neighborhoods with high crime rates, especially violent crimes (aggravated assault with guns), contributes to stressful living environments (Sampson, Raudenbush, & Earls, 2009). Unfortunately, observed racial disparities in PTB rates between Blacks and Whites may in part be explained by such socioeconomic disadvantage. Blacks, a marginalized minority, are disproportionately represented in the most stressed urban neighborhoods (Hynes & Lopez, 2009). A weakness to date of health disparities research is that all too often the Black population is treated as a homogeneous group, even though it is diverse, and even when based on nativity, that is, the country of birth. During the past several decades, there has been a tremendous increase in immigration from Africa and the Caribbean. In fact, in some U.S. cities such as New York and Miami, one fourth of the Black population is foreign born (Kent, 2007). To advance understanding of how nativity may affect birth outcomes among Black mothers, studying similarities or differences in stressful residential exposures may provide important insight. Perhaps similar social determinants contributing to the observed racial and ethnic disparities among Black and White mothers also exist among foreign-born Black and U.S.-born Black mothers.

## **Geographical Information Systems: An Innovative Technology to Study Environmental Exposures**

To push nursing science forward to advance knowledge that can be translated to practice, innovative geographical database technologies can help elucidate important geo-spatial patterns occurring in residential living environments. Although the provision of nursing care is primarily focused at the level of the individual and her family, nurses must not ignore contextual factors related to where people live. Better understanding of contextual environmental factors that hinder or facilitate health and use of health care services is warranted, especially for populations in which racial and ethnic disparities in health and health care use exist.

Eliminating social and health inequities is a major objective of our nation; however, quantifying and monitoring socioeconomic disparities in health are hampered by the lack of socioeconomic data in most public health surveillance systems (Springer, Samuel, & Bolan, 2010). With the advent of technologies, such as geographical information systems (GIS), a

new repertoire of strategies is possible. These strategies import a plethora of data and create thematic maps that reveal spatial variations and relationships with geographical locations of where specific phenomena occur (e.g., crime, poverty, and health outcomes).

A GIS is a software application that utilizes data that has a spatial attribute associated with it to conduct robust geographic analyses. For example, socioeconomic and health data can be imported and layered to specific spatial geographic points illuminating relationships that would otherwise be unseen. Creating GIS databases to study health and relevant social science variables is a promising research strategy to better understand social determinants of health (Higgs, 2009; Lovett, Haynes, Sunnenberg, & Gale, 2002). Geographical information system software uses cartography (the art and science of making maps) that includes projected shape files in which every location has a point of latitude and longitude that can be assigned to hierarchical spatial areas from one geographical point, such as an individual address, to many points that constitute larger geographical areas, such as neighborhoods, counties, or even countries. With GIS, individual health events can be linked to larger areas by geocoding individual addresses to their particular latitude and longitudinal points on a geographical map. This software operates in a similar fashion to the geographic software applications that makes applications programs, such as Google maps and global positioning systems (GPS), possible.

The purpose of this article is to examine geographical spatial patterns and relationships among the prevalence of PTB with race, poverty, crime, and nativity in Philadelphia at the aggregate level. Neighborhood poverty and crime were used to represent exposure to stressful living environments. Crime variables of aggravated assault with gun and domestic abuse were used to capture exposure to ambient violence (violence outside and inside home), and GIS was used to develop a geographic database to generate thematic maps.

## Theoretical Framework

Two theories were merged to direct this program of study: Culhane's model of chronic maternal stress as a contributing factor to increased rates of PTB within socioeconomically disadvantaged populations and Meleis' framework for understanding vulnerabilities and health care needs of immigrant women. Culhane posited that multilevel factors at individual and contextual levels cause chronic maternal stress that may lead to endocrine and immune system dysregulation causing increased susceptibility to infection and PTB (Culhane & Elo, 2005; Wadhwa et al., 2001). Meleis identified different dimensions at the individual level that affect health status of immigrants, including reasons, adaptations, and marginalization in their migration transitions (Meleis, 2010; Meleis, Lipson, Muecke & Smith, 1998). Meleis' framework embraces the heterogeneity among immigrants based on the aforementioned dimensions in their transition from their country of birth to the United States. In this research, environmental context was studied to assess whether differential stressful environmental exposures could explain some of the variance contributing to observed disparities in PTB rates between foreign-born Black and U.S.-born Black mothers.

## Methods

This study was a secondary analysis of existing data imported into GIS, a geographically rooted computer technology that combines hardware, software, and data to display and analyze spatial and nonspatial information (Wong & Hillier, 2001). Data were obtained from three sources: 2000 U.S. Census data; deidentified geocoded 2003–2005 Philadelphia birth records; and publicly available 2004 Philadelphia Police Department crime statistics. Review and approval for this research, including a waiver of informed consent to use the

specified existing data, was obtained from the university's Institutional Review Board (IRB).

### Sample and Setting

Philadelphia was the setting for this study, in which 381 neighborhoods are defined by census tract boundaries. Philadelphia's infant mortality rate increased from 10.3% from 2000 to 11.2% in 2006, which was consistently higher than the national rate of 6.9% in 2000 and 6.7% in 2006 (Philadelphia Department of Health, 2009). The Black infant mortality rate remains higher than infant mortality of White and other ethnicities, with higher rates of PTB explaining the differential.

### Key Variables

In this study, differential exposure to stressful living environments between foreign-born Black and U.S. born Black mothers was explored. Key variables used in this study were neighborhoods, poverty, ambient violence, race, nativity, and PTB.

**Neighborhoods and Creation of the GIS Database**—To identify Philadelphia neighborhoods in a relational geographical database, Shapefiles and Microsoft Excel files of existing data were imported into ArcGIS software to create the database for this study. Shapefiles, used in ArcGIS software, are files that contain a set of points, arcs, or polygons (or features) that hold tabular data of spatial locations (Clemmer, 2010). The geospatial data for Philadelphia are available publicly from the U.S. Census Bureau as TIGER/Line (U. S. Census Bureau, 2010). These data sets include key geographic features such as administrative boundaries (cities, zip codes, census tracts), natural features (rivers), and transportation networks (roads, railways).

Census tracts, an administrative boundary designated by the U.S. Census Bureau, were used to simulate the neighborhood spatial boundaries. Census tracts are relatively permanent statistical geographical subdivisions containing about 4,000 residents on average (generally between 1,500 to 8,000). Using census tracts have become the “gold standard” unit of analysis for neighborhood research (Krieger et al., 2003), including previous research of neighborhood context with adverse birth outcomes (Geronimus, 1996; Subramanian, Chen, Rehkopf, Waterman, & Krieger, 2006).

**Neighborhood Poverty**—Neighborhood poverty was used in these analyses as a proxy for neighborhood deprivation. Although researchers have used multiple U.S. 2000 Census variables for devising creative and complex indices of neighborhood deprivation (Holzman et al., 2009; O'Campo et al., 2008), using percent of persons below the poverty level has been consistently stable, whereas mixing in other variables such as education, occupation, and wealth have not been consistently reliable (Krieger et al., 2003). It is well documented that neighborhoods with high poverty are characterized by disadvantaged social environments (Robbins & Webb, 2004; Wilson, 1995; Wilson & Neckerman, 1987). Therefore, for this study, percent poverty was used to approximate neighborhood economic deprivation. This is defined in terms of the percentage of persons with household incomes below the U.S. federal poverty level, a threshold that varies by size and composition of the household. Data were downloaded from publicly available 2000 U.S. Census Bureau Summary Tape File (STF) 3A (U.S. Census Bureau, 2001).

**Race**—Race is used by the U.S. Census Bureau and reflects self-identification by people according to the race or races with which they most closely identify. These categories are sociopolitical constructs and should not be interpreted as being scientific or anthropological in nature. Furthermore, race categories include racial and national-origin groups. There are

six categories (White, Black or African American, American Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander) for race. For this analysis, the two races under study are White and Black. The 2000 U.S. Census defines *White* as a person having origins in any of the original peoples of Europe, the Middle East, or North Africa. It includes people who indicate their race as White or report entries such as Irish, German, Italian, Lebanese, Near Easterner, Arab, or Polish. *Black* is defined as a person having origins in any of the Black racial groups of Africa. It includes people who indicate their race as Black, African American, or Negro or provide written entries such as African American, Afro-American, Kenyan, Nigerian, or Haitian. These data were downloaded from 2000 U.S. Census website (U. S. Census Bureau, 2001).

**Nativity and Ethnic Density**—Nativity is determined from the variable in the U.S. 2000 Census data that is labeled “place of birth” as U.S. born or foreign born. The population surveyed included all people who indicated that the United States was their usual place of residence on the census date (U.S. Census Bureau, 2001). The foreign-born Black population included immigrants (legal permanent residents), temporary migrants (e.g., students), humanitarian migrants (e.g., refugees), and unauthorized migrants (people illegally residing in the United States). Ethnic density for this study was identified as a percentage of the population at the neighborhood level (census tracts) of the particular ethnicity. Patterns of racial/ethnic segregation will be explored along with particular attention in assessing whether ethnic enclaves, population clusters of foreign-born Blacks, can be detected using GIS with 2000 U.S. census data for Philadelphia county.

**Ambient Neighborhood Violence**—This variable *ambient neighborhood violence* was defined as geographic exposure to violence inside the home and outside the home using crime data on reported “aggravated assaults with guns” and reported “domestic abuse” during 2004. This definition was confirmed with an expert panel of crime analysts. These data were retrieved through the Philadelphia Neighborhood Information System (NIS) CrimeBase (2009), publicly available through the Cartographic Modeling Lab at the University of Pennsylvania (<http://cml.upenn.edu/crimebase>). The data originate from the Police Department’s Incident Transmittal System, and this database represents a record of incidents to which the Police Department has responded and categorized at the time of response. However, if the investigation resulted in a recategorization of the incident after this 5-day window, it was not changed in the database. The numbers represented are, at best, a snapshot of crime in Philadelphia. All data were aggregated to the census tract level, and no identifiers of individuals exist in this publicly available data. Homicides were depicted as aggravated assaults because victims might have died at a later date after being shot. Location coordinates used to aggregate the data have been based on the Streets Department’s Street Centerline file.

**Preterm Birth**—*Preterm birth* was defined as a birth in which the gestational age was <37 weeks. Philadelphia birth records were used to identify all Philadelphia resident PTBs from 3 years (2003–2005). All birth records used in this study were deidentified and geocoded and obtained in Microsoft Excel files with a six selected variables. These variables were birth weight (in grams), gestational age, mother’s race and ethnicity, mother’s country of birth, county of residence, and census tract of residence. The Microsoft Excel files were obtained only after permission to use these already deidentified and geocoded birth records was granted by the institutional review board. This study was a secondary analysis of the existing geocoded birth record data set that was created for a previously conducted perinatal epidemiology maternal-infant health outcomes study to assess individual health in the context of the neighborhood’s health (Culhane et al., 2002). In this study, only aggregated neighborhood-level perinatal health exposures were assessed.

The country of birth variable, added to Pennsylvania birth certificates in 2003, was used to distinguish foreign-born Black mothers from U.S.-born Black mothers. This variable was a two-letter string variable that represented country codes. Before 2003, information about nativity could not be obtained from Pennsylvania birth records. For this analysis, a dummy code was created to identify U.S.-born versus foreign-born mothers. All births born to mothers that had “US” in this variable were identified as “U.S.-born.” All births that did not have “US” in this variable were identified as “foreign born.” For decades, birth records have been an important source of data for birth outcomes research with proven reliability (Vinikoor, Messer, Laraia, & Kaufman, 2010).

## Study Procedure

**GIS Data Management and Analysis**—U.S. 2000 Census and Philadelphia crime data were downloaded from the specified websites directly as Microsoft Excel files, which were then aggregated at the census tract level. Before importing these files into ArcGIS 9.3.1, they were carefully reviewed to explore and identify important features of variable distributions at the aggregate level and transformed, as needed, for GIS. A unique GIS database was established for this study using Arc-GIS 9.3.1 (specific brand of GIS software). All Microsoft Excel files were systematically joined in attribute files within the GIS database. Attribute tables in each shape file were studied reviewing frequency and central tendency statistics across levels of aggregation for each variable. Tracts that had small to no population, or were nonresidential, were excluded from the study.

Decisions on how best to represent data spatially by creating thematic maps were based on understanding the data and creating multiple maps using various tools of ArcGIS. Before representing all variables under study, systematic cartographic approaches were used to study spatial relationships for variables individually, then for variables in various combinations. Particular geographic clusters for poverty, PTB, race/ethnicity, nativity, and violence within the population were explored. Confirmatory analyses of particularly striking visual patterns were conducted with descriptive statistics using Stata 11.0 data analysis and statistical software. “Best to worse” neighborhood categories were created based on the distribution of the data in relation to the central tendency of the neighborhood poverty and crime variables.

## Results

Philadelphia has 381 census tracts. Census tracts without any residential areas were excluded as were census tracts with fewer than 10 births during the combined 3-year period. That left 350 census tracts that were used for this study in which there were geocoded 61,418 births during years 2003–2005. The recorded gestational age for 2,490 births was 99, which indicated missing data, so these were excluded. Only Philadelphia resident births were included in these analyses. In this sample of births, 28.9% ( $n = 17,723$ ) were to White mothers whose infants had a mean gestational age of 38.7 weeks; 49.3% ( $n = 30,301$ ) were to Black mothers whose infants had a mean gestational age of 38.2 weeks. Of these Black mothers, 20.3% ( $n = 6,136$ ) were foreign born.

Across Philadelphia census tracts, the mean percent of residents living beneath the U.S. poverty level was 22% ( $SD = 15.5$ ). There were 18 census tracts in which  $>52\%$  of the households were living beneath the poverty level. As a result of mapping the data, the geographical patterns of environmental exposures to stress were readily observed (see Figure 1). There appears to be overlapping layers of neighborhoods burdened with poverty, violence on the streets, and violence inside the homes, as evidenced by the results of mapping reported assaults with guns and reports of domestic abuse. Figure 2 illustrates that there were neighborhoods that were either predominately White or predominately Black.

Then, comparing Figure 2 to Figure 1, another spatial relationship emerged; exposure to environmental stress is much more predominate in Black neighborhoods.

Next, the spatial relationships of PTB were explored. These results appear in Figure 3, which show a consistent pattern with the previous maps. For this sample, the PTB rate during the three year period (2003–2005) among White mothers was 9.7% ( $n = 1,736$ ) compared to 14.0% ( $n = 4,227$ ) among Black mothers. The PTB rate among foreign-born Black mothers (13.8%,  $n = 846$ ) was not very different than the overall PTB rate of all Black mothers. Also, they follow the same geographical patterns of clustering in neighborhoods burdened with stress. Perhaps “foreign-born” nativity is not protective in such residential neighborhoods.

To further assess nativity with neighborhood exposures and PTB, the variance of environment exposures of poverty and crime (domestic abuse and assault with guns) within Philadelphia was determined. Means of the three environmental stress variables were calculated and then different ways to categorize the neighborhood stress variance were explored revealing the most efficient way to describe the variance was in quartiles. All neighborhoods (census tracts) were ranked relative to the central tendency distribution of the variables. Neighborhoods were categorized according to how relatively good or bad they were in comparison to the mean values of the city with the following four categories: best, good, bad, and worst. Table 1 reveals that nativity within the same neighborhood category was not significant, but between categories of neighborhoods, nativity was significant ( $\chi^2 = 57.8$ ,  $p < .0001$ ). A higher prevalence of foreign-born Black mothers reported living in the better neighborhoods compared to U.S.-born Black mothers (see Table 1). However, for all Black mothers, the majority of them report living in the worst Philadelphia neighborhoods. Note that the totals reported in Table 1 are less than the totals reported from the GIS analyses. The GIS analysis was derived from functions built into the attribute tables. However, the results reported in Table 1 were conducted using Stata 11, a robust statistical software frequently used in epidemiology analyses. The Stata analysis was directed by a biostatistician, and not all births were included in the analysis due to concerns with the data.

## Discussion

This study demonstrated the powerful use of GIS and clearly illustrated important health outcomes with social science variables that portray contextual factors of stressful living environments. GIS is an important tool to use in the context of the life course perspective of reproductive health (Lu & Halfon, 2003), a major policy initiative throughout the United States as a strategy to decrease poor birth outcomes (Malnory & Johnson, 2011). The complex interplay of social and economic factors that affect overall health of individuals, families, and communities is underscored in the life course perspective. Healthy mothers are more likely to have healthy babies. Those who live in healthier environments have better health trajectories throughout their life. Of note, in Healthy People 2020 there are now four overarching goals (U.S. Department of Health and Human Services, 2010). A new Healthy People 2020 goal is to create social and physical environments that promote good health for all. Researchers need to consider methods to capture and measure the environment. GIS in addition to complex hierarchal statistical modeling are powerful methodological tools that have been used to confirm the neighborhood impact on adverse birth outcomes (Li et al., 2010). However, interpretation of complex statistical terms can be confusing and not nearly as readily interpreted as the maps produced by GIS. GIS is a powerful tool for research, policy, and practice.

From the maps produced in this study, racial segregation in this urban setting and the spatial patterns of the adverse environmental exposures with the adverse health outcome of PTB

were clearly portrayed. This should be no surprise, as “residential segregation is a distinguishing organizational feature of African-American life that profoundly affects its residents” (Collins & Schulte, 2003, p. 227). Using GIS technology, the hyper-segregation of Blacks in Philadelphia and their overrepresentation in the poorest, unsafe environments are unequivocal. The root causes of these tremendous problems are beyond the scope of this article, and the reader is directed to the broader social science literature of health inequities and racism.

Enclaves of foreign-born Black residents may exist in Philadelphia. However, based on findings from these GIS maps, if they exist in the stressed neighborhoods, birth outcomes appear to be just as much at risk. This may be just the beginning of the story of differences between foreign-born and U.S.-born Blacks residing and birthing in Philadelphia. Delving into the stories and embracing the heterogeneity of Blacks in Philadelphia may provide insights to particular vulnerabilities. Clearly there are “hot spots” in which the residents are at greater risk for poverty, violence, and adverse health outcomes. Aggregating the data into one area is misleading; so great caution is needed before drawing any conclusions. However, it can direct future researchers to sharpen their research questions and hypotheses.

### Limitations

The data have a variety of limitations that affect preliminary conclusions that could be made. First, individuals live their lives in overlapping environments that include, for example, their residence, work, and/or school. These may all be within the same neighborhoods or not. In addition, the data are cross-sectional in nature. It is unknown how long the identified residence on birth records was the mother’s residence. Therefore, although the maps reflect spatial relationships among the variables of interest, protective or toxic neighborhood exposures are not necessarily stable over time.

A specific limitation of the birth records was the variable used for nativity. Pennsylvania added the field code “country of birth” to birth certificates in 2003. Prior to that, information about the birth mother’s nativity was not available from birth records. As a result of further analysis of this string variable, a problem with the data was discovered. Among the 6,136 foreign-born Black mothers, two thirds of all records that were not filled with United States as the country of birth were filled with ZZ in the Microsoft Excel file, but no country code corresponds to ZZ. Despite checking with a variety of local experts to get more insight, there was no definitive explanation. It is possible that the country of origin was not clear to the abstractor of the birth records, especially if the mother was foreign born and handwriting was illegible. Alternatively, it is possible that there was a technology problem in the database, but these are only speculations. However, as a secondary analysis using a variable that was added during the last revision of vital statistics, the reliability and validity for this particular variable has not been established as other variables that have been used for decades (Kirby, 2001). Obviously, this is an important limitation, and further research to assess reliability of the country of birth variable used in birth record surveillance systems is warranted. Ensuring accurate information on birth certificates is critical, and its importance needs to be emphasized to all involved.

Next, the issue of endogeneity of neighborhood context (i.e., issue of those from inside the neighborhood as a function of the neighborhood as a system) needs to be addressed. This preliminary analysis sought spatial patterns among only a few variables to determine similarities between foreign-born and U.S.-born Black mothers. Although visual patterns in the maps appeared, caution is necessary as the analysis used only a few study variables. Inferences cannot be made about causality of any of the observed patterns, as individuals choose, to some extent, where to live. The problem of endogeneity, whereby unobserved variables are most likely related to both exposures (crime and poverty), and outcomes



(neighborhood birth rates and PTB) must be considered and needs further exploration. From a sociological perspective, neighborhoods provide exogenous influence shaping the culture of its residents; while, the residents within the neighborhood provide endogenous influence on the culture of the neighborhood (Kaufman, 2004).

## Implications for Nursing

In nursing practice, individual-level interventions predominate, but the complex web of causation necessitates an ecological approach pushing deeper theoretical understandings about where people live. Although the root causes of why disproportionately more Black mothers live in the worst neighborhoods are beyond the scope of this article, there are important implications for nurses. Nurses can use GIS to better understand living environments of mothers and their families and to target interventions in geographical areas with the greatest service needs. Identifying the social-cultural context of patients' addresses has the potential for informing and guiding health planning and implementation of more effective, targeted, and tailored interventions for individuals within their communities.

Nursing assessments should include questions about housing, transportation, and neighborhood safety. Find out how safe the mother feels in her neighborhood. If immediate postpartum care to evaluate blood pressure or a cesarean is needed, find out how she will travel to care. Does she need to take several buses? Will she have to take along all her children, including the newborn? Adhering to treatment plans may be particularly burdensome and not feasible for mothers living in the worst neighborhoods.

Nurses need to be advocates for vulnerable populations and raise important questions. Without addressing macrolevel factors in tandem with microlevel interventions, health care professionals will not be able to address health inequities as manifested in the devastating racial disparities in PTB rates and infant mortality. In previous research, foreign-born Black women seemed to be at less risk for PTB. However, the findings of this study indicate that toxic neighborhood exposures seem to trump nativity. Foreign born was not protective for Black mothers living in the worst neighborhoods. More Blacks from foreign countries are migrating and having babies in the United States than ever before (Kent, 2007). How can nurses facilitate optimal transitions? Will their health deteriorate over time when transitioning to a country in which they become a marginalized minority when they were not in their country of birth? Of concern is if the epidemiology paradox documented with Mexican immigrants will occur (Ruiz et al., 2008; Zambraba et al., 1999). These important questions warrant further research.

## Conclusions

In examining the neighborhoods of Philadelphia, it was visually clear that patterns exist above and beyond individual-level characteristics. Social characteristics vary systematically across communities along dimensions of poverty, residential segregation, crime, and adverse birth outcomes (PTB). Delving deeper into these areas is warranted with the promise of elucidating modifiable factors for which strategic and tailored interventions could be developed to protect against PTB and reduce racial and ethnic disparities.

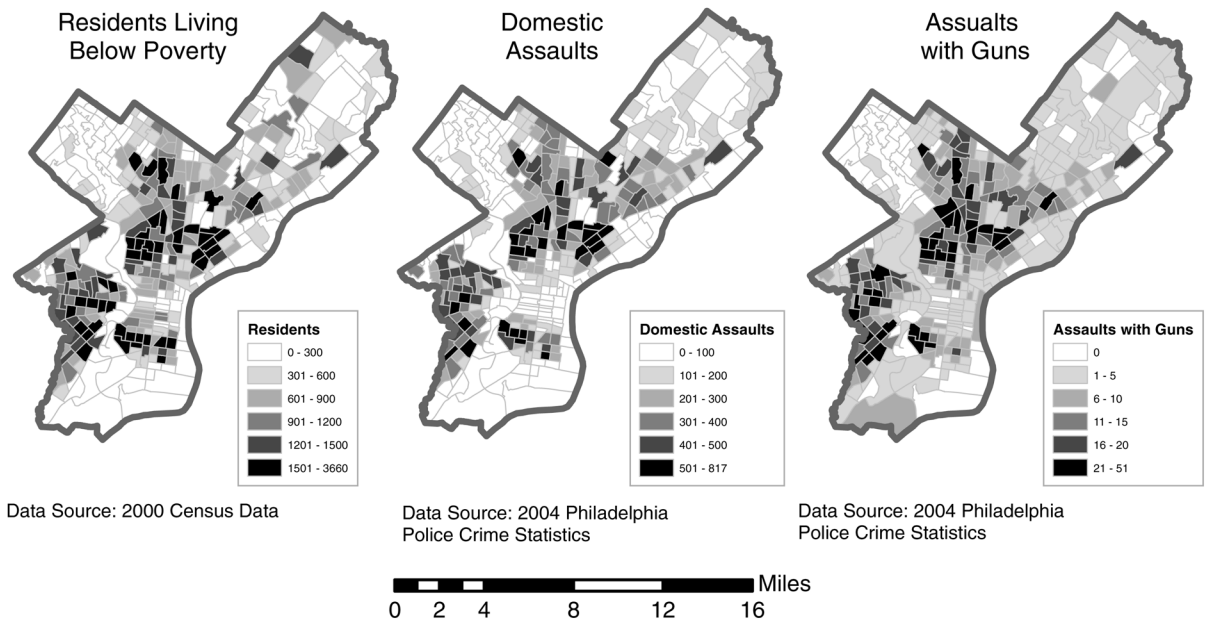
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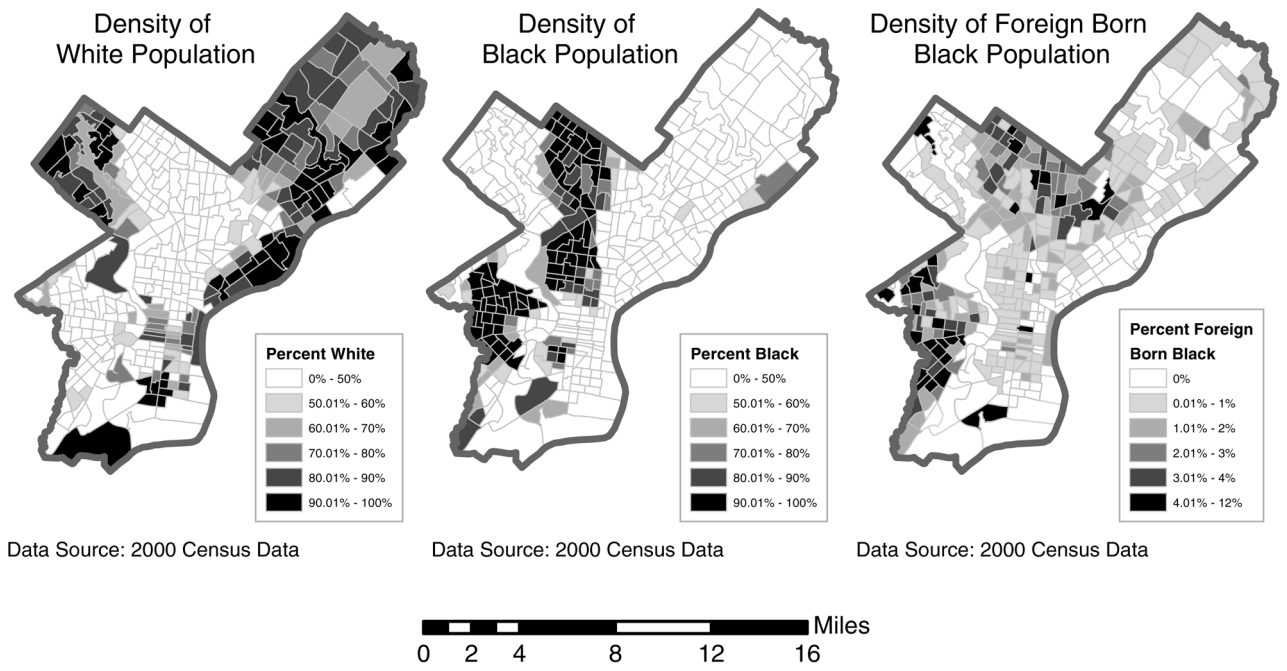
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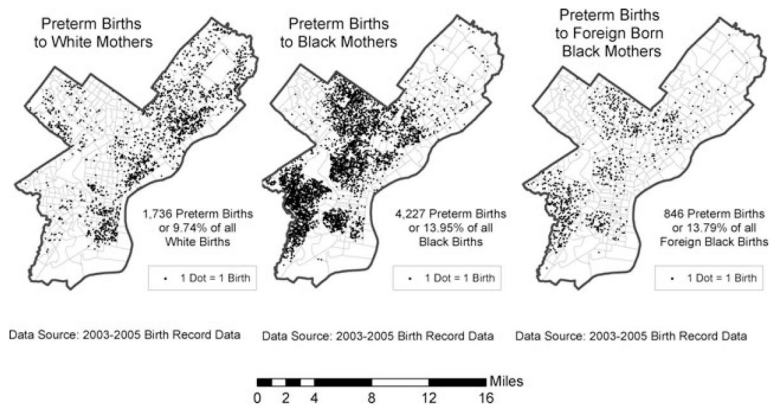
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**Figure 1.**  
Environmental stress in Philadelphia by census tract.



**Figure 2.**  
Ethnic population density by Philadelphia census tract.



**Figure 3.**  
Preterm birth density in Philadelphia by race and nativity.

Table 1

Distribution of Preterm Births (2003–2005) Among Neighborhood Categories and Nativity among Black Mothers<sup>a,b</sup>

Neighborhood Category*	All births% (n = 58,913)	PTB births% (n = 7,311)	US-Born Black Births% (n = 23,204)	US-Born Black PTB Births % (n = 3,380)	Foreign-born Black <sup>c</sup> Births% (n = 5,875)	Foreign-born Black <sup>b</sup> PTB Births% (n = 846)
Best	36.6	31.3	20.0	18.6	22.1	18.8
Good	11.9	11.9	10.4	10.7	12.2	13.7
Bad	13.0	14.0	17.1	16.4	18.6	18.7
Worst	39.5	42.9	52.5	54.2	47.1	48.8

Note. PTB = preterm birth.

<sup>a</sup>This was a post-hoc analysis after the Microsoft Excel files were imported into the geographic information system (GIS). After maps revealed patterns, the Microsoft Excel files were imported into Stata software. Data cleaning caused eliminating observations for multiple reasons.

<sup>b</sup>The numbers in each column were rounded off to one decimal point, so the totals may not be exactly 100.

<sup>c</sup>Foreign born for this study was defined as birth records that had a code entered, but not "US" in the birth certificate field which was a string variable.

\*  $p < 0.0001$  (significance for difference between the four neighborhood categories; no significance within each neighborhood category).