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Using GIS to Visualize Relationships Between Perinatal Outcomes and Neighborhood Characteristics When Planning Community Interventions

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Q8

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ABSTRACT

Objective: To describe maternal morbidity, birth outcomes, and neighborhood characteristics of urban women from a racially segregated city with the use of a geographic information system.

Design: Exploratory neighborhood-level study. Existing birth certificate data were linked and aggregated to neighborhood-level data for spatial analyses.

Setting: Southern city in New Jersey.

Sample: Women and their 7,858 live births that occurred between 2009 and 2013.

Methods: Secondary analyses of extant sources were conducted. Maternal health and newborn birth outcomes were geocoded and then aggregated to the neighborhood level for further exploratory spatial analyses through our geographic information system database. An iterative process was used to generate meaningful visual representations of the data through maps of maternal and infant health in 19 neighborhoods. Q1

Results: The racial and ethnic residential segregation and neighborhood patterns of associations of adverse birth outcomes with poverty and crime were illustrated in geographic information system maps. In 43% of the births, women had a documented medical risk. Significantly more preterm births occurred for Black women ($p < .01$) and women older than 35 years of age ($p = .01$). The rate of diabetes was greater in Hispanic women, and the rate of pregnancy-related hypertensive disorders was greater in Black women.

Conclusion: Data-driven maps can provide clear evidence of maternal and infant health and health needs based on the neighborhoods where mothers live. This research is important so that maternity care providers can understand contextual factors that affect mothers in their communities and guide the design of interventions.

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AWHONN

Racial and ethnic health disparities in adverse perinatal health outcomes persist among Black and Hispanic mothers who live in specific urban neighborhoods. Exposure to chronic and cumulative stress is now understood to be a reason why marginalized minority women have greater rates of preterm births, the leading cause of infant mortality, and other chronic illnesses than White women (McKinnon et al., 2016). Contextual factors related to adverse social determinants of health, specifically the neighborhoods where mothers live, are recognized as important factors that relate to observed maternal and infant health disparities and must be taken into account in nursing research, education, and practice (Bloch & Cordivano, 2016).

Nurses are involved in preparing mothers to care for themselves during pregnancy and as they recover after childbirth during the postpartum period. Knowing information about neighborhoods where mothers live and related patterns of health (e.g., diabetes, hypertension) and health outcomes (e.g., preterm birth) can allow perinatal health care interventions to be more effectively tailored. Nurses interact with women during the childbearing year through a variety of clinical and public health services that may include prenatal and postpartum ambulatory care settings, inpatient and outpatient clinical settings, and a variety of community public health–funded programs, such as home visiting and Healthy Start programs. Although some of the services that nurses

provide to childbearing women are actually situated in their neighborhoods, many clinical services are not located in residential neighborhoods. Health care providers may not be attuned to actual neighborhood nuances or how social determinants affect perinatal health care needs and perinatal health outcomes.

As community-engaged participatory action initiatives in research and practice gain momentum (Jerome-D'Emilia & Jackson, 2016), it is wise to learn as much as possible about neighborhoods. Geographic information systems (GISs) are useful technology-enhanced data visualization tools that can be used to better understand neighborhood characteristics and the health of the residents based on an array of extant data. Accessing such data and mapping them to neighborhoods can be illuminating to nurses and the communities they serve. In this study, we focused on an understudied city affected by high rates of crime and poverty. Building on previous research conducted with low-income women in the postpartum period (Suplee, Gardner, & Borucki, 2014), we sought to understand the neighborhoods where the women resided. The purpose of this study was to use GIS software, data about neighborhood characteristics, and mothers' birth information to enhance our contextual understanding of this particular impoverished urban area.

Background

The elimination of health disparities, the achievement of health equity, and the improvement of the health of all groups are overarching goals established by Healthy People 2020 (HealthyPeople.gov, 2017). In general, the identification of specific, individual-level, demographic, socioeconomic, and behavioral factors to explain racial and ethnic disparities in health outcomes research has not been successful (Elo & Culhane, 2010). Racial and ethnic perinatal health disparities are associated with living in environments with poverty, unemployment, greater crime rates, and residential segregation (Braveman et al., 2015). The U.S. Census Bureau (2017) defined *poverty* as "a set of money income thresholds that vary by family size and composition to determine who is in poverty. If a family's total income is less than the family's threshold, then that family and every individual in it is considered in poverty" (para. 1). Understanding social determinants of health can better guide the development of feasible and relevant interventions to reduce

observed racial and ethnic health disparities: "Disparities in birth outcomes, therefore, are the consequences of differential exposures during pregnancy and differential developmental experiences across the lifespan" (Fine, Kotelchuck, Adess, & Pies, 2009, p. 3). Neighborhood deprivation and its correlation to greater rates of preterm birth have been documented (Anthopolos, Kaufman, Messer, & Miranda, 2014).

One of the most influential outcomes reflective of a country's overall health and well-being is its rate of infant mortality (Centers for Disease Control and Prevention [CDC], 2012). The United States was ranked 57th in infant mortality based on 2016 estimates (Central Intelligence Agency, 2017a); this ranking is due in large part to documented racial and ethnic health disparities. Despite improved health care resources, such as technologically advanced NICUs and better screening and interventions for maternal complications during pregnancy, the infant mortality rates in the United States have remained fairly constant over the past decade. In 2013, one third of the infant mortalities in the United States were related to preterm birth causes (CDC, 2017c). The U.S. maternal mortality rate is just as concerning: the United States is ranked 46th globally, based on 2015 estimates (Central Intelligence Agency, 2017b), and is one of eight countries where the maternal mortality rate is increasing (Kassebaum et al., 2014). The most current pregnancy-related mortality ratio in the United States, reported for 2013, is 17.3 deaths per 100,000 live births (CDC, 2017b). In addition, the rate of severe maternal morbidity in the United States has more than doubled since 1998 (Callaghan, Creanga, & Kuklina, 2012).

Racial and ethnic maternal health disparities persist. Black women are 2 to 3 times more likely to die during or after childbirth than White women (CDC, 2017b). Martin, Hamilton, Osterman, Driscoll, and Mathews (2017) reported additional concerning U.S. birth statistics for 2015: a cesarean rate of 32% (Black women, 35.5%; Hispanic women, 32%; and White women, 31%), a preterm birth rate of 9.6% (Black infants, 13.4%; Hispanic infants, 9.1%; and White infants, 8.9%), and a teen (ages = 15–19 years) pregnancy rate of 22.3% (Black teens, 32%; Hispanic teens, 35%; and White teens, 16%). The March of Dimes [Q2] (2016) noted a preterm birth rate of 9.8% in New Jersey for 2015, slightly greater than the national rate (Black women, 13%; Hispanic women, 9.4%; and White women, 8.9%).

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