



Living in violence: Neighborhood domestic violence and small for gestational age births



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ABSTRACT

Objectives: To determine the association between neighborhood domestic violence and small-for-gestational-age (SGA) birth and to examine if there is a differential impact of neighborhood domestic violence on SGA births by race in a high crime community.

Methods: This analysis includes all birth records issued in New Orleans, Louisiana from 2011 to 2012 geocoded by census tract (N=177 census tracts, N=8322 women). Hierarchical modeling and ecologic spatial analysis were used to examine the area-effect of neighborhood domestic violence on SGA births, independent of individual-level predictors and accounting for the propensity to live in high domestic violence neighborhoods. **Results:** Tests for spatial autocorrelation revealed area-level clustering and overlap of SGA and domestic violence rates. Pregnant women living in high domestic violence areas were more likely to give birth to an SGA infant compared to women in low-domestic violence areas (OR=1.04, 95%CI: 1.01, 1.08), net of the effects of individual-level factors and propensity scores.

Conclusion: Neighborhood-level attributes including rates of domestic violence may increase women's risk for SGA birth, highlighting a policy-relevant and potentially amenable exposure.

1. Introduction

In the United States, Black women experience disproportionately higher rates of adverse birth outcomes relative to other women. Black women are 1.5 times more likely than White women to give birth to a small-for-gestational-age (SGA) infant, twice as likely to have a pre-term birth (PTB), and three times as likely to give birth to a low birth weight (LBW) infant (Wallace et al., 2015; Culhane and Elo, 2005). Differences in individual-level characteristics (i.e., socioeconomic status, education, health behaviors, and access to medical care) do not fully explain these racial disparities in birth outcomes (Ananth et al., 2003; Nepomnyaschy, 2009; McDermott et al., 1999). Efforts to understand why risk differences persist are increasingly focused on broader, contextual factors beyond individual characteristics, with the understanding that the environment in which people live, work, and grow can influence health (Wentz et al., 2014; Metcalfe et al., 2011; Kawachi and Berkman, 2003; O'Campo et al., 2008; Witt et al., 2015; Ncube et al., 2016). Previous explorations of neighborhood-level determinants of adverse birth outcomes have predominantly focused on socioeconomic indicators such as poverty and unemployment rates, median household income, and the concentration of economic disadvantage that occurs in racially segregated areas (O'Campo et al.,

2008; Pearl et al., 2001). While area-level socioeconomic disparities have been consistently associated with adverse birth outcomes, socioeconomic conditions alone fail to capture the multiple ways in which neighborhood context influences racial disparities in women's health (Witt et al., 2015; Messer et al., 2006a), and there is a need to better understand the mechanisms through which neighborhood conditions may impact birth outcomes (Metcalfe et al., 2011).

Stress is a commonly cited pathway through which exposure to disadvantage is thought to have a deleterious effect on birth outcomes (Uchino, 2006). Research focused on physiological stress pathways demonstrates that chronic exposure to stress may lead to excess circulating corticotrophin-releasing hormone and cortisol, which in turn, may stunt fetal growth (Wallace et al., 2015; Uchino, 2006). Additionally, chronic stress exposure can lead to dysfunction of maternal cardiometabolic processes, contributing to the pathogenesis of intrauterine growth restriction, which may lead to SGA birth (Wallace et al., 2015; Uchino, 2006; Weetman, 1999). Given the established relationship between stress and adverse perinatal outcomes (Wilson et al., 2004; Gomez et al., 2004; Chandola, 2001), violent crime – and fear of crime – may be an important source of neighborhood stress for women and their children and may play a role in perinatal health. Neighborhood violence has been associated with

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health outcomes such as higher rates of smoking, depression, and lower rates of physical activity (Messer et al., 2006a; Masi et al., 2007). Previous studies on crime and reproductive health have linked high crime neighborhoods to higher rates of LBW and SGA in Chicago, (Collins and David, 1997; Morenoff, 2003) and higher rates of PTB in North Carolina (Messer et al., 2006a). A recent systematic review concluded that exposure to neighborhood disadvantage – including crime – significantly increased women's risk for an adverse birth outcome (Metcalfe et al., 2011). It has been hypothesized that persistent exposure to violent crime induces stress response, which predisposes pregnant women to adverse birth outcomes. However, several studies have found that the impact of neighborhood context on birth outcomes differs by maternal race. One study found that living in neighborhoods with the highest and second highest quartiles of crime rates compared with the lowest quartile was associated with increased odds of preterm birth for Black women only (Messer et al., 2006b). Two other studies found that living in less deprived or higher income neighborhoods increased the risk of preterm birth for Black women but not for White women (Messer et al., 2006a; Kaufman et al., 2003); yet, another study found that living in areas of high concentrated disadvantage were associated with adverse birth outcomes for White women, but not for Black women (O'Campo et al., 2008; Ncube et al., 2016). Reasons underlying the differential impact by race remain unclear but may be related to larger structural forces, including structural racism, exposure over the life-course, or even more proximal neighborhood conditions as well as differences in coping with stress (Rutter and Nikapota, 2002).

One form of violence that has yet to be examined at an aggregate level in relation to birth outcomes is domestic violence. Domestic violence is common in the U.S., including violence against children as well as intimate partner violence (IPV). The lifetime IPV prevalence rate reported by women is 25%, and considering more common forms of IPV, such as emotional and psychological abuse, it is believed that 1 in 3 women worldwide will be abused in her lifetime (Heise et al., 1999). Violence during pregnancy may lead to pregnancy complications or adverse birth outcomes through direct or indirect mechanisms (Petersen et al., 1997; Boy and Salihu, 2004; Shah and Jyotsna, 2010) and may be responsible for increased fetal deaths in affected pregnancies at a rate of 16.0 per 1000. (Boy and Salihu, 2004) The prevalence of IPV is disproportionately high among young Black women (Raiford et al., 2007), with rates reported as high as 40%, and may be a significant source of stress among pregnant women (Malik et al., 1997).

In addition to variation in the types of neighborhood violence examined, key methodological considerations in the research on neighborhood conditions and adverse birth outcomes have been limited. Selection bias is a problematic feature of many previous studies on neighborhood context and birth outcomes, and methods to minimize the effects of such bias propensity score matching has rarely been done in studies examining neighborhood influences on adverse birth outcomes (Morenoff, 2003). Selection bias occurs from social sorting mechanisms whereby individuals choose where to live. Propensity score methods are one approach to reduce such bias, making exposure groups more comparable; however, it is impossible to fully remove the effect of selection bias (Oakes, 2006). It is important to consider that individuals do not randomly chose where to live and those living in high deprivation and crime stricken areas may be different from those who do not live in such areas. These differences may be related to birth outcomes and if not accounted for can confound the exposure-outcome association.

Previous studies have not only failed to address potential selection bias, but also spatial autocorrelation of adjacent neighborhoods (i.e. exposure clustering), which can also produce biased results (Messer et al., 2006a; Morenoff, 2003). In all but one study (Morenoff, 2003) on neighborhood effects and birth outcomes, neighborhoods are assumed to be independent entities, ignoring the broader spatial context in which neighborhood effects are embedded. The social environment of

adjacent neighborhoods can influence outcomes, suggesting that neighborhood interdependence and proximity should be considered in statistical analysis. Failing to account for spatial autocorrelation when spatial dependency is present can lead to an overestimation in significance levels of contextual effects and incorrect inferences about the exposure-outcome relationship. Given the variability in race-stratified findings and the lack of research that has used robust empirical analysis (i.e., accounting for structural confounding and spatial dependence), further evidence building is warranted not only to determine the impact between exposure to neighborhood domestic violence and adverse birth outcomes, but also whether the impact of such exposure—as a more proximal consequence of deprived or impoverished areas—may explain racial disparities in birth outcomes.

This study examines the association and spatial distribution of neighborhood-level domestic violence rates and adverse birth outcomes among non-Hispanic (NH) Black and NH White women in New Orleans, Louisiana. The objectives of this analysis were twofold: (1) to determine the contribution of neighborhood domestic violence on SGA births, accounting for spatial autocorrelation, propensity to live in high domestic violence neighborhoods, and individual-level characteristics, and (2) to examine if there was differential impact of neighborhood domestic violence on SGA births by race. We hypothesized that after controlling for individual-level variables, women living in neighborhoods with high domestic violence rates would be more likely to experience a SGA birth compared to women living in neighborhoods with low domestic violence rates.

2. Methods

2.1. Individual-level measures

Data included in this analysis came from multiple sources. Individual-level data on mothers and infants included the 2011–2012 Louisiana Vital Statistics computer-registry of birth certificate data. This data included information on birth weight (grams), gestational age (weeks), maternal education (less than high school, high school graduate, some higher education, bachelor's degree or higher), maternal racial identification (NH Black, NH White), maternal age (continuous), health insurance status (private, Medicaid, other), women, infants, and children (WIC) program status, smoking during pregnancy, previous birth outcome events, parity, and maternal address at time of birth. The primary outcome of interest, SGA, was defined as an infant with birth weight below the 10th percentile of weight for a given gestational age. We additionally explored associations with preterm birth (< 37 weeks gestation) and LBW (< 2500 g). For this study, and due to the population distribution in New Orleans (33% White, 60% Black), the sample was restricted to NH White and NH Black women (n=8322).

2.2. Neighborhood-level measures

Neighborhood definitions were based on the 2010 Census TIGER/Line Shapefile for Louisiana census tract boundaries. Orleans parish is comprised of 177 census tracts. Of the 177 census tracts, 4 were excluded from statistical analysis due to low population estimates (i.e. < 500 individuals), leaving a total of 173 census tracts. The New Orleans Police Department provided domestic violence data based on incidents of 911 calls reporting domestic events by census tract, including aggravated assault, aggravated battery, domestic disturbance, simple assault and simple battery. The neighborhood domestic violence rate was calculated by summing the counts of domestic violence calls in each census tract and dividing the total sum by the 2012 population of that census tract for a rate per 1000 residents. Analysis was based on a 10-unit increase in the rate of neighborhood domestic violence per 1000 population.

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