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Neighborhood Gun Violence and Birth Outcomes in Chicago

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Abstract

Objectives To examine the association between gun violence and birth outcomes among women in Chicago.

Methods Using a 5-year set of birth files (2011–2015) merged with census and police data, birth outcomes including low birth weight (LBW, BW < 2500 g), preterm birth (PTB, < 37 weeks gestation), and small-for-gestational-age (SGA, BW < 10th percentile) were examined among non-Hispanic (NH) white, NH black, and Hispanic women in Chicago. Gun violence rates were categorized into tertiles. Multilevel, multiple logistic regression examined the effects of gun violence and race/ethnicity on birth outcomes.

Results Of 175,065 births, 10.6% of LBW, 10.6% of PTB, and 9.1% of SGA occurred in high violence tertile. Using white women in low violence tertile as reference, the OR for LBW among black women ranged 1.9–2.1 across all tertiles, and 0.8–1.2 among Hispanic women. OR for PTB for black women were 1.6–1.7 and 1.0–1.2 for Hispanic women, and OR for SGA for black women were 1.6–1.7 and for Hispanic women 0.9–1.0.

Conclusions for Practice In Chicago, race/ethnicity was associated with birth outcomes, regardless of the level of exposure to gun violence, in 2011–2015. The differences in racial/ethnic composition across the violence exposure levels suggest that, rather than gun violence alone, residential segregation and the geographic inequities likely contribute to disparate birth outcomes.

Keywords Racial disparities · Preterm birth · Low birth weight · Gun violence

Significance

What is already known on this subject? The striking racial/ethnic disparity in birth outcomes in this country are not fully explained by individual level risk factors. With a growing body of literature on contextual factors' effects on health, there is an emerging evidence on the health effects of violence, but the results on birth outcomes have been inconsistent.

What this study adds? Race/ethnicity is strongly associated with birth outcomes, regardless of the amount of exposure to gun violence. We speculate that this reflects the high degree of segregation in the city, and lifelong health disparities therein.

Introduction

Low birth weight (LBW, birth weight < 2500 g), preterm birth (PTB, birth at < 37 weeks gestation) and small for gestational age (SGA, birth weight for gestational age < 10th percentile) are major determinants of infant morbidity and mortality (Matthews et al. 2015) in the United States. After a period of decline, preterm birth rate increased again in 2016 (Martin et al. 2017), and the racial disparity in poor birth outcomes continues to persist (Hamilton et al. 2015). PTB and LBW rates remain notably higher among non-Hispanic black (13.8%, 13.7% respectively) women compared to non-Hispanic white (9.0%, 7.0%), and Hispanic (9.5%, 7.3%) women (Martin et al. 2017).

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Individual level risk factors, such as sociodemographic characteristics and prenatal care utilization, fail to completely explain the African-American women's persistent reproductive disadvantage (Collins and David 1990; Murray and Bernfield 1988). A growing body of literature has shown that women's lifelong contextual experiences, including the physical and social environment of residence crime rates (Masi et al. 2007; Messer et al. 2006), racial segregation (Bell et al. 2006; Kramer et al. 2010), neighborhood poverty (Janevic et al. 2010; Metcalfe et al. 2011; Schempf et al. 2011) and income inequality (Huynh et al. 2005; Olson et al. 2010)—contribute to the racial disparity in poor birth outcomes (Buekens and Klebanoff 2001; Kramer 1987; Kogan 1995; Parker et al. 1994; Wilcox et al. 1995; Ahern et al. 2003; Kaufman et al. 2003; Pearl et al. 2001; Pickett et al. 2002; Rauh et al. 2001; Roberts 1997), but little remains known about the underlying biological mechanisms.

Perceived neighborhood disorder has been associated with high levels of anxiety, anger, and isolation, mediated by feelings of personal victimization, powerlessness, and normlessness (Ross and Mirowsky 2001). Response to such psychological distress may mediate a physiological stress response, leading to poor health (Hill et al. 2005). Such is the concept of allostatic load, or the cumulative wear and tear on the body's systems owing to repeated adaptation to stressors (McEwen and Seeman 1999; Seeman et al. 1997). As a marker of chronic stress that is higher in non-whites (Geronimus et al. 2006), allostatic load has been recognized as a potential contributor to racial disparities in birth outcomes (Wallace and Harville 2013).

Given the biologic plausibility that allostatic load mediates the effect of stress on health, it is possible that neighborhood gun violence affects birth outcomes differentially by race/ethnicity. Recent studies have examined birth outcomes and their association to violence in terms of warzone conflict and large-scale escalation in violence in Mexico, while others have reported on extreme events such as landmine explosions, bomb casualties, or the 9/11 attacks, with mixed results. To our knowledge, however, there are limited recent data on the relationship between gun violence, race/ethnicity, and birth outcomes in a large metropolitan city like Chicago, where the races are exposed to the extremes of residential environment, with African-Americans disproportionately residing in neighborhoods with high rates of gun violence (Walker et al. 2016; Wintemute 2015).

Therefore, we designed a population-based study to determine the relationship between neighborhood gun violence, race/ethnicity and birth outcomes (PTB, LBW, and SGA) among women in Chicago over a 5-year period (2011–2015). We hypothesized that exposure to high rates of gun violence is a risk for poor birth outcomes compared to exposure to low rates of gun violence, independent of individual- and neighborhood-level risk factors, and that the effects differ by race/ethnicity.

Methods

We obtained the 2011–2015 Illinois Department of Public Health computerized vital records of singleton infants born to women residing in Chicago at the time of delivery. Only infants born to non-Hispanic black, non-Hispanic white, and Hispanic women with complete addresses were analyzed. Multiple gestation births, births with major congenital anomalies, and births with incomplete or missing addresses were excluded. Each birth was geocoded to census tracts within the city boundary.

Appended to the birth file were 2011–2015 gun violence records from the Chicago Police Department (CPD). Each crime in the dataset is entered with crime type, date, and census tracts geocoded for each reported incident of violence. Crimes in this study were restricted to those defined as "public violence" by the CPD, which we named "gun violence" for this study. This category of crime is almost exclusively gun-related violence that occurs in public places, and includes homicides, sexual assault, certain types of robbery, battery, aggravated assault, and weapons violations. This category of crime was chosen because it is potentially a relevant indicator of the extent to which a resident would experience crime as a perceptible and noticeable influence on his/her neighborhood environment.

Also appended were 5-year (2011–2015) estimates of census-tract level population count, rates of poverty, unemployment, and high school graduation from the U.S. Census Bureau.

The study was approved by the Ann & Robert H. Lurie Children's Hospital of Chicago Institutional Review Board, University of Illinois at Chicago Institutional Review Board, and Chicago Department of Public Health Institutional Review Board.

Maternal race and ethnicity variables in birth certificates were used to define non-Hispanic (NH) White, Hispanic and non-Hispanic Black women.

The outcomes of interest were rates of preterm birth (PTB, gestational age < 37 weeks), low birth weight (LBW, < 2500 g), and small-for-gestational-age (SGA, weight-for-gestational age < 10th percentile) (Fenton 2003) births. Gestational age and birth weight were obtained from vital statistics. Gestational weeks were entered in birth certificates based on obstetrical estimates. Subjects missing gestational age or birth weight, or those with improbable combinations of gestational age and birth weight, were deleted from analysis.

The primary exposure of interest was gun violence rate. Gun violence rate was calculated for each census tract as:

(average number of gun violence incidents in a census tract per year/population in census tract) × 1000. Gun violence rates were then categorized into tertiles using the Jenks natural breaks classification method in ArcGIS (Version 10, Environmental Systems Research Institute, Inc., Redlands, CA). Briefly, natural breaks classes are based on natural groupings inherent in the data, so that breaks are identified that best group similar values and maximize the differences between classes (de Smith et al. 2006). Low tertile (0–5.6 gun violence incidents per 1000 residents per year) represented the areas with low violence rates, followed by medium tertile (5.7–17.0), and high tertile (≥17.1).

Maternal and infant characteristics, and neighborhood level indicators of socioeconomics, were compared across violence tertiles using Kruskal–Wallis test for categorical variables and one way ANOVA for continuous variables. Infant characteristics included sex, proportion of LBW, PTB, and SGA. Maternal characteristics included race/ethnicity, age, educational attainment, marital status, parity, hypertension during pregnancy, previous preterm birth, cigarette smoking, insurance status and participation in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) during pregnancy. Neighborhood-level covariates included census tract level rates of unemployment rate, high school graduation or equivalent rate, and individual poverty.

To inform later model building, we performed gun violence tertile-specific stratified analysis and tested for homogeneity of these stratum-specific ORs (alpha = 0.05) across individual and neighborhood-level covariates to identify potential effect modifiers of the gun violence-birth outcome relationship, which was race/ethnicity.

Multilevel regression analyses were performed to account for geographic clustering of birth outcomes. Using individual-level (level 1) and census tract-level (level 2) data, we built hierarchical models to investigate the relationship between LBW, PTB, and SGA and gun violence. Models were fit to assess the association between gun violence, race/ethnicity and each birth outcome using PROC GLIMMIX in SAS; multilevel logistic regression models incorporated randomly distributed census tract-specific intercepts assuming a binary distribution and a logit link function. Bivariate analyses were performed to examine the association between gun violence tertiles and each birth outcome. Adjustments for confounders were made when the crude OR differed from the adjusted OR for each confounder by 10% or more in bivariate analyses (Maldonado and Greenland 1993). Odds ratios (OR) with 95% confidence intervals (CI) were calculated for all models. A total of three multilevel regression models were computed for each birth outcome, adjusting for the following covariates: Model 1—none; Model 2—individual-level confounders, which included maternal age, marital status, education, smoking, prenatal care and insurance status; Model 3—all factors from Model 2, in addition to neighborhood-level covariates, which included census tract-level rates of poverty rate and high school graduation rate.

To study the potential modifying effect of race/ethnicity on gun violence-birth outcome association, we stratified the sample into NH white, NH black, and Hispanic women, using those in the low violence tertile for reference. In a separate analysis, we used NH white women in the lowest violence tertile as reference, versus all others (i.e. NH whites in medium violence tertile, NH whites in high tertile, NH blacks in low tertile, NH blacks in medium tertile, NH blacks in high tertile, Hispanic in low tertile, Hispanics in medium tertile, and Hispanics in high tertile.)

Data were analyzed using SAS statistical software (Version 9.4, SAS Institute, Cary, NC) and ArcGIS software (Redlands, CA). Descriptive analyses were performed to provide means and percentages. Continuous variables and categorical variables were examined with ANOVA across three tertiles of gun violence.

Results

There were 175,065 births in the analysis, after excluding multiple gestation births, births with congenital anomalies, and those with incomplete or missing addresses at the time of delivery.

During the years 2011–2015, the average annual gun violence rate in Chicago was 5.4 per 1000 residents, ranging from 0 to 61.0 reported incidents. Approximately 8.1% of women lived in areas with the highest rates of gun violence (17.1–61.0), 25.1% in areas with medium rates of gun violence (5.7–17.0), and 66.8% in areas with the lowest rates of gun violence (0–5.6). Table 1 shows the distribution of LBW, PTB and SGA birth outcomes by tertiles. Areas in low, medium, high tertiles of gun violence had 6.4%, 9.4% and 10.6% LBW rates, 7.8%, 9.8%, 10.6% PTB rates, and 5.6%, 8.0%, and 10.7% SGA births, respectively.

Demographic characteristics of the study population are also shown in Table 1, by gun violence tertiles. Neighborhoods in high tertile of gun violence had greater proportions of NH black women at 74.7% versus 20.1% NH white women. Women in high violence tertile were also of younger age, lower education, inadequate prenatal care, single marital status, higher parity, lower education and increased enrollment in Medicaid, compared to those in low violence tertile. The high violence tertile also had a higher proportion of women with history of diabetes, hypertension during pregnancy, smoking, and previous poor outcomes, compared to women in the low violence tertile. Rates of neighborhood socioeconomic indicators of hardship (unemployment, lack of high school graduation, individual poverty rates) were in

Table 1 Birth outcomes and demographics by gun violence tertiles

Gun violence tertiles Gun violence rates per 1000/year	Tertile 1 Low 0–5.6 (n = 118,341) 66.8%	Tertile 2 Medium 5.7–17.0 (n = 44,468) 25.1%	Tertile 3 High 17.1–61.0 (n = 14,395) 8.1%	p
Low birth weight (%)	7552 (6.4)	4156 (9.4)	1522 (10.6)	< 0.0001
Preterm birth (%)	9216 (7.8)	4369 (9.8)	1519 (10.6)	< 0.0001
Small-for-gestational-age (%)	6652 (5.6)	3551 (8.0)	1311 (9.1)	< 0.0001
Infant and maternal characteristics				
Infant sex (%)				
Female	58,055 (49.1)	21,677 (48.8)	2044 (48.9)	0.535
Male	60,286 (50.9)	22,791 (51.3)	7351 (51.1)	
Race/ethnicity (%)				
NH White	49,019 (41.4)	5370 (12.1)	1328 (9.2)	< 0.0001
NH Black	23,791 (20.1)	24,663 (55.5)	10,752 (74.7)	
Hispanic	45,531(38.5)	14,435 (32.5)	2315 (16.1)	
Education (%)				
< High school	21,111 (18.1)	12,063 (27.5)	3515 (25.7)	< 0.0001
≥ High school	95,469 (81.9)	31,848 (72.5)	10,730 (75.3)	
Inadequate prenatal care (%)				
Yes	24,493 (20.7)	13,342 (30.0)	4728 (32.8)	< 0.0001
Married (%)				
Yes	68,013 (57.5)	12,991 (29.2)	3205 (22.3)	< 0.0001
Parity (%)				
0	41,663 (35.2)	13,762 (23.0)	4394 (30.5)	< 0.0001
1, 2	53,828 (45.5)	19,483 (43.8)	6152 (42.7)	
3 +	22,850 (19.3)	11,223 (25.2)	3847 (26.7)	
Hypertension (%)				
Yes	1627 (1.4)	848 (1.9)	342 (2.4)	< 0.0001
Diabetes (%)				
Yes	5655 (4.8)	1856 (4.2)	469 (3.3)	< 0.0001
Previous PTB (%)				
Yes	3011 (2.6)	1193 (2.7)	430 (3.1)	0.001
Age (%)				
< 20	8144 (6.9)	6075 (13.7)	2124 (14.8)	< 0.0001
20–34	85,663 (72.4)	32,676 (73.5)	10,677 (74.2)	
35 +	24,525 (20.7)	5713 (12.9)	1594 (11.1)	
Smoke (%)				
Yes	2356 (2.0)	2173 (4.9)	919 (6.4)	< 0.0001
WIC use (%)				
Yes	47,308 (41.3)	26,974 (62.0)	8555 (60.6)	< 0.0001
Medicaid (%)				
Yes	59,424 (50.2)	32,656 (73.4)	10,557 (73.3)	< 0.0001
Prev poor outcome (%)				
Yes	1718 (1.5)	977 (2.2)	401 (2.9)	< 0.0001
Alcohol use (%)				
Yes	674 (0.6)	333 (0.8)	106 (0.7)	< 0.0001
Neighborhood characteristics				
Poverty rate, mean (SD)	19.2 (12.3)	33.3 (12.4)	34.3 (12.3)	< 0.0001
Unemployment rate, mean (SD)	10.7 (7.1)	20.4 (9.8)	23.7 (7.5)	< 0.0001
No HS grad rate, mean (SD)	17.8 (17.4)	21.0 (17.2)	16.7 (11.6)	< 0.0001

Chicago, Illinois 2011–2015

Table 2 Associations between birth outcomes and joint effects of race/ethnicity and gun violence

	Tertile 1 Low violence 0–5.6 (n = 118,341) aOR (95% CI)[a]	Tertile 2 Medium violence 5.7–17.0 (n = 44,468) aOR (95% CI)	Tertile 3 High 17.1–61.0 (n = 14,395) aOR (95% CI)
Low birth weight			
NH White	Ref.	1.02 (0.88–1.19)	1.10 (0.83–1.44)
NH Black	2.04 (1.87–2.23)	2.10 (1.88–2.35)	1.88 (1.63–2.17)
Hispanic	1.21 (1.12–1.31)	0.95 (0.84–1.07)	0.79 (0.63–0.99)
Preterm birth			
NH White	Ref.	0.99 (0.87–1.13)	1.03 (0.80–1.32)
NH Black	1.69 (1.56–1.84)	1.67 (1.50–1.86)	1.58 (1.37–1.83)
Hispanic	1.20 (1.12–1.29)	1.06 (0.95–1.18)	0.95 (0.77–1.17)
SGA			
NH White	Ref.	0.96 (0.82–1.13)	1.19 (0.89–1.58)
NH Black	1.68 (1.53–1.84)	1.74 (1.55–1.96)	1.82 (1.55–2.13)
Hispanic	0.98 (0.91–1.07)	0.98 (0.86–1.12)	0.91 (0.71–1.17)

Chicago, Illinois 2011–2015

[a]Adjusted individual characteristics included maternal age, marital status, education, smoking, prenatal care and insurance. Adjusted neighborhood characteristics included individual poverty rate and high school graduation rate per census tract

parallel with rates of gun violence, such that the highest rates of these indicators were in the highest gun violence tertile.

The results of multilevel regression models for the joint effect of race/ethnicity and gun violence on birth outcomes, using NH white women in low violence tertile as reference, are shown in Table 2. Compared to NH white women in the low tertile, the adjusted odds of LBW births among NH black women in low tertile equaled 2.04 (1.87–2.23), NH black women in medium tertile equaled 2.10 (1.88–2.35), and NH black women high tertile equaled 1.88 (1.63–2.17). For Hispanic women, the adjusted odds ranged 0.8–1.2 across low, medium, and high tertiles, compared to NH white women in the low tertile. Similarly, adjusted odds of PTB for NH black women ranged 1.6–1.7 and for Hispanic women 1.0–1.2, and adjusted odds of SGA for NH black women ranged 1.7–1.8 and 0.9–1.0 for Hispanic women, compared to NH white women in low tertiles. Another set of multilevel regression models, run separately by race/ethnicity, using women of each race/ethnicity in low tertile as reference, showed no association between gun violence and any of the birth outcomes (Table 3).

Finally, we plotted the distribution of women's residence in each violence tertiles by race/ethnicity in a bubble chart (Fig. 1). Each bubble size represents the proportion of women of each race/ethnicity residing in low, medium, and high gun violence tertile areas. Births were asymmetrically distributed by gun violence exposure across race/ethnicity;

Table 3 Associations between birth outcomes and gun violence tertiles in each race/ethnicity

	Tertile 1 Low violence 0–5.6 (n = 118,341) aOR (95% CI)[a]	Tertile 2 Medium violence 5.7–17.0 (n = 44,468) aOR (95% CI)	Tertile 3 High 17.1–61.0 (n = 14,395) aOR (95% CI)
Low birth weight			
All races/ethnicities	Ref.	1.11 (1.05–1.18)	1.21 (1.11–1.32)
NH White	Ref.	1.01 (0.87–1.18)	1.11 (0.85–1.45)
NH Black	Ref.	1.03 (0.97–1.10)	1.06 (0.98–1.15)
Hispanic	Ref.	0.96 (0.89–1.05)	0.90 (0.74–1.08)
Preterm birth			
All races/ethnicities	Ref.	1.05 (1.00–1.11)	1.10 (1.02–1.19)
NH White	Ref.	0.99 (0.87–1.13)	1.06 (0.83–1.35)
NH Black	Ref.	1.02 (0.95–1.09)	1.01 (0.93–1.10)
Hispanic	Ref.	0.94 (0.87–1.01)	0.91 (0.77–1.08)
Small for gestational age			
All races/ethnicities	Ref.	1.12 (1.05–1.19)	1.23 (1.13–1.34)
NH White	Ref.	0.96 (0.82–1.12)	1.13 (0.86–1.50)
NH Black	Ref.	1.03 (0.95–1.11)	1.07 (0.98–1.18)
Hispanic	Ref.	1.10 (0.99–1.21)	1.01 (0.81–1.26)

Chicago, Illinois 2011–2015

[a]Adjusted individual characteristics included maternal age, marital status, education, smoking, prenatal care and insurance. Adjusted neighborhood characteristics included individual poverty rate and high school graduation rate per census tract

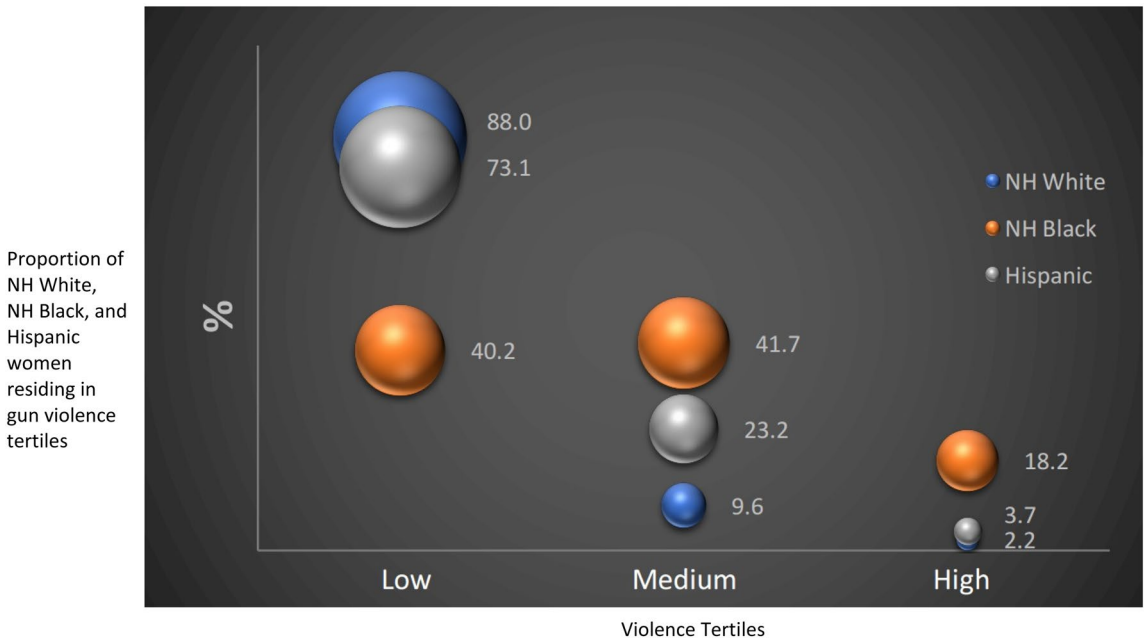

Fig. 1 Distribution of women's residence in violence tertiles by race/ethnicity, Chicago, Illinois 2011–2015 (Color figure online)

60% of births to NH black women occurred in medium and high gun violence areas, compared with only 27% of births to Hispanic women and 12% of births to NH white women.

Discussion

Our population-based study provides new information that there was an association between birth outcomes and race/ethnicity, regardless of the level of exposure to gun violence, in Chicago in 2011–2015. The differences in racial/ethnic composition across the city geography, with variations in gun violence, suggest that residential segregation and the geographic inequities likely contribute to disparate birth outcomes, rather than gun violence alone.

Our findings add to a small but growing body of literature on violent events and their relationship to birth outcomes. A study by Messer et al. found no significant association between neighborhood crime (violence, theft, property, and vice) and preterm birth after adjustment for maternal characteristics and neighborhood-level deprivation scores (Messer et al. 2006). Morenoff et al. also described a relationship between violent crime and birthweight, which, however, attenuated after controlling for individual covariates (Morenoff 2003). Others have focused on violence escalation or extreme, largely unexpected violent events, such as terrorist attacks, bombings and landmine explosions or onset of conflict. Mansour and Rees (Mansour and Rees 2012), for example, reported that in the West Bank and Gaza during the second Intifada, a higher number of non-combatant fatalities were associated with a modest fall in birth weight. In Mexico, Brown (2018) found that early pregnancy exposure to the escalation in drug-related violence was associated with a substantial decrease in birth weight.

More recently, a study in Brazil found that exposure to local violence, measured by homicide rates, led to a small but increased risk of low birth weight and prematurity (Koppensteiner and Manacorda 2016). Notably, these effects were found both in small municipalities, where homicides are rare, and in large municipalities, where violence is endemic. The effects were smaller in the violence-endemic areas, leading the authors to speculate whether each additional homicide has smaller adverse consequences on birth outcomes than when homicides are rare, possibly due to a process of adaptation.

Potential mechanisms through which violence affects birth outcomes are speculated to be repeated exposure to stress leading to "allostatic load," the physiological costs of chronic over- or under-activity of physiologic systems to meet demands of environmental stressors. Geronimus (1992) has argued that prolonged exposure to high-stress neighborhood environments can take a cumulative toll on maternal health in the form of "weathering." There are also theoretical reasons for violence as a primary source of stress, such as increased fear of crime among women than among men (Warr 1994), higher risk of mental health problems related to stress among people who perceive more crime in their neighborhoods (Aneshensel and Sucoff 1996), and social isolation due to distrust of others (Krause 1993).

These were the basis of our initial hypothesis, that in any race/ethnicity, gun violence would be associated with poor birth outcomes. Instead, our findings showed effect modification between violence and race/ethnicity. Compared to NH white women, NH black women had increased odds of all three poor birth outcomes, regardless of the level of exposure to gun violence. Even NH black women living in the low violence tertile had 1.7 to 2-fold higher odds of delivering LBW, PTB and SGA births, compared to NH white women in the low violence tertile.

The differential effect of violence by race/ethnicity has been described before. Masi et al. have reported the association between racial/ethnic group density and birth weight, which was stronger among NH whites and Hispanics than among NH black women in Chicago, using 1990–1991 census, crime, and birth data (Masi et al. 2007). They found that group density was strongly associated with PTB, while violent crime rate was more strongly associated with SGA, suggesting that group density and violent crime may impact birth weight via different mechanisms.

The observed joint effects of gun violence and race/ethnicity in our study are likely related to other social determinants in disadvantaged communities that are closely related to gun violence. Residential segregation is recognized as such a risk factor of racial disparities in birth outcomes (Kramer and Hogue 2009), hypothesized to mediate through neighborhood disadvantage such as concentrated poverty, exposure to environmental stressors, and limited access to healthcare services (Acevedo-Garcia 2000; Kramer and Hogue 2009). The reality of residential segregation in Chicago was apparent when we compared the racial/ethnic composition of women by gun violence tertiles. We speculate that a NH black woman living in low, medium, or high violence areas may be already chronically exposed to structural racism and socioeconomic disadvantages inherent in her neighborhood geography, such that exposure to gun violence alone has little to add to her life-long load of risk factors for poor birth outcomes.

In our results, Hispanic women had odds of LBW, PTB and SGA births that were essentially no different than non-Hispanic white women, despite residence in medium and high violence areas. This may be a manifestation of the Hispanic Paradox (Franzini et al. 2001), the phenomenon that Hispanic and Latino Americans tend to have health outcomes that "paradoxically" are comparable to, or in some cases better than, those of white counterparts, despite lower socioeconomic status. In epidemiologic literature, potential explanations for the paradox have included selective migration of healthy women (Franzini et al. 2001), social support and access to networks (Bender and Castro 2000), and the promotion of healthier behaviors in Hispanic cultures (McGlade et al. 2004). It should be noted that our measure of Hispanics was an aggregate, and additional analyses by subgroups of Hispanic women are necessary to delineate potential differences by Hispanic subgroups as well as maternal birthplace.

There were several other limitations in this study. First, births were presumed to be among women who were residents within the city limits of Chicago at the time of delivery, but we had no information as to residential stability, or how long the mothers lived at the reported addresses. Second, there is an inherent bias in crime report data, where reporting may have been subject to systematic biases. Crime data depend on individuals recognizing and reporting crime and the police responding to the report. Violent crimes may have been underrepresented in disadvantaged areas because residents report only the most serious crimes. Third, we were not able to include other contextual factors such as neighborhood social support and cohesion.

In summary, we found that, at the population level in Chicago, exposure to gun violence differs markedly by race/ethnicity, but does not appear to be associated with poor birth outcomes when maternal race/ethnicity is taken into account. In fact, remarkably, even in the most violent neighborhoods, where 75% of NH black women resided, 90% of births were born at full term gestation, normal birth weight, or appropriate weight for age—perhaps indicating a reproductive resilience among women facing the most severe adversities.

Preventing gun violence is paramount to improve neighborhood equity, but gun violence alone does not appear to be contributing to racial disparities in birth outcomes in Chicago. Future studies including other proxy measures of structural racism, such as residential redlining, that may impact infant health outcomes, are warranted to clarify this relationship.

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