Associations of Neighborhood Crime with Adverse Pregnancy Outcomes among Women in Chicago: Analysis of Electronic Health Records from 2009-2013

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Abstract

Background: Adverse pregnancy outcomes are associated with higher cardiovascular disease risk among mothers and future health problems of offspring. Neighborhood crime may contribute to adverse pregnancy outcomes by increasing chronic stress, yet the association has been relatively understudied.

Methods: Electronic health records from 34,383 singleton births at a single hospital in Chicago (2009-2013) were geocoded and linked to one-year rates of police-recorded crime at the neighborhood (Chicago community area) level. Crimes included homicide, assault/battery, criminal offenses, and incivilities. Cross-sectional associations of total neighborhood crime rates with hypertensive disease of pregnancy (HDP: pre-eclampsia/gestational hypertension), preterm birth (PTB), spontaneous preterm birth (sPTB), and small-for-gestational-age (SGA) birth were assessed using multilevel logistic regression with community-area random intercepts. Models controlled for maternal and infant characteristics and neighborhood poverty. We then assessed associations between individual crime categories and all outcomes.

Results: Total neighborhood crime rates ranged from 11.6 to 303.5 incidents per 1,000 persons per year (mean: 61.5, SD: 40.3). A 1-SD higher total neighborhood crime rate was associated with higher odds of HDP (OR: 1.06, 95% CI: 1.00, 1.13), PTB (OR: 1.09, 95% CI: 1.03, 1.15), sPTB

(OR: 1.09, 95% CI: 1.03, 1.16) and SGA (OR: 1.05, 95% CI: 1.01, 1.10) in fully adjusted models. Associations were generally consistent across crime categories, although only assault/battery and incivilities were associated with HDP.

Conclusions: Higher neighborhood crime rates were associated with small but significant increases in the odds of adverse pregnancy outcomes. Interventions that cultivate safer neighborhoods may be a promising approach for improving pregnancy outcomes.

Keywords

Neighborhoods/Place; Pregnancy

INTRODUCTION

Adverse pregnancy outcomes such as preterm birth and low birth weight put infants at risk for a variety of health conditions throughout the lifespan.[1-4] In addition, adverse pregnancy outcomes have been associated with future cardiovascular disease among women. [5-8] Large socioeconomic and racial/ethnic disparities in adverse pregnancy outcomes are a persistent public health problem,[9, 10] and may result from disadvantage occurring at the individual, family, or neighborhood level.[9] The neighborhood environment has emerged as an important area for investigation that may contribute to these disparities.[11, 12]

Prior research on pregnancy outcomes has largely focused on neighborhood socioeconomic status, incorporating factors like neighborhood poverty, unemployment, income, and education.[9, 11-13] However, residents of socioeconomically-disadvantaged neighborhoods also experience greater rates of neighborhood crime, and crime has been suggested as a more proximal exposure than economic advantage in the association of neighborhood characteristics with adverse pregnancy outcomes.[14, 15] Exposure to crime has been found to increase psychological distress[16] and may contribute to chronic stress.[17] Chronic stress may lead to adverse pregnancy outcomes both directly through hormonal and neuroendocrine changes that may trigger preterm birth or restrict fetal growth,[18, 19] and indirectly thorough health behaviors. Pregnant women who experience stress due to neighborhood crime may use unhealthy behaviors, such as smoking and drinking alcohol, as a coping mechanism,[20, 21] and may be less likely to participate in healthy behaviors like physical activity[22] that may reduce the risk of developing adverse outcomes.[23]

To date, relatively few studies have examined associations of neighborhood crime with adverse pregnancy outcomes in comparison to other neighborhood exposures like neighborhood socioeconomic status. Also, prior studies that have examined neighborhood crime have not examined associations of with hypertensive disease of pregnancy.[14, 21, 24-27] In addition, prior studies of crime and pregnancy outcomes have largely used birth certificate data, which may underreport pregnancy complications or previous maternal medical conditions.[28-30] Electronic health records (EHRs) are a promising data source that may better capture these outcomes and potential confounders. As such, our objective was to examine associations of neighborhood crime with hypertensive disease of pregnancy, preterm birth, and small for gestational age birth among a racially and ethnically diverse cohort of women in Chicago using electronic health record data.

METHODS

Study Population

Our study sample came from the Northwestern Medicine Enterprise Data Warehouse, an electronic health record repository. We extracted records for all women delivering singleton infants at Northwestern University's Prentice Women's Hospital in Chicago, Illinois, from January 1, 2009 to December 31, 2013 (N=60,826 births among 46,690 women). We included records from all women whose addresses during pregnancy could be successfully geocoded and who resided within the Chicago city limits in order to enable linkage of neighborhood crime rates.

Patient addresses were geocoded in ArcMap version 10.5 (Environmental Systems Research Institute, Redlands, CA). Residential addresses for a total of 57,866 births (95%) were successfully geocoded, and 40,798 were within the Chicago city limits. We subsequently excluded 514 births (1%) with missing/implausible demographic or clinical information, and restricted to each woman's first birth during the study period (5,901 later births excluded), for a final total of 34,383 included births. Excluded births were more likely to be among white women and those with private insurance, and were less likely to have adverse pregnancy outcomes (Supplemental Table 1). As only first births during the study period were included, excluded births were also more likely to be among older and multiparous women. The Northwestern University Institutional Review Board approved this study.

Outcomes

Adverse pregnancy outcomes were defined using data extracted from electronic health records, including gestational age, birth weight, and problem lists/diagnostic codes. Outcomes included hypertensive disease of pregnancy, preterm birth, and small for gestational age birth (SGA). Hypertensive disease of pregnancy was defined as either gestational hypertension or preeclampsia during the current pregnancy; the field for this outcome had no missing data. Preterm birth, defined as gestational age at birth of less than 37 weeks, was missing for 149 births (<1%). We examined both any preterm birth and spontaneous preterm birth to assess whether associations varied between spontaneous and medically indicated preterm birth. Finally, SGA was defined as birthweight below the 10th percentile for a given gestational age,[31] and was missing for 284 births (<1%). A prior study comparing electronic health record extraction to manual abstraction found differences in abstracted birth outcomes to be small.[32]

Neighborhood Crime Exposure

Crime data came from the City of Chicago's Data Portal,[33] which published a database of all police-recorded crimes occurring within the Chicago city limits. We obtained crime data for years 2008-2013. Crimes were categorized using Illinois Uniform Crime Reporting codes according to a previously published classification scheme.[22, 34] Categories included: homicide, assault and battery, criminal offenses (e.g. robbery, sexual assault, arson, kidnapping), and incivilities[35] (non-violent crimes that may be indicators of neighborhood physical and social disorder, e.g. narcotics, prostitution, vandalism, weapons

violations). We excluded crimes that occurred on an airplane/in an airport as these crimes are unlikely to affect perceptions of neighborhood safety.

In this study, neighborhood crime was operationalized at the community-area level. Chicago is divided into 77 community areas, which are well-defined, static neighborhoods designated by the Social Science Research Committee at the University of Chicago and officially recognized by the city of Chicago. Prior work suggests that crime operates as an area-level rather than individual-level exposure;[26] as such, capturing crime exposures at a larger geographic level such as community area may be more relevant than capturing according to individual buffers (e.g. crime within a 1-mile radius of residential address).

Crime exposures were linked to women by community area. For each birth, we created a count of the number of crimes (total, and for each crime category) in the mother's community area of residence within a 12-month period preceding the date of delivery. We then calculated population-normalized crime rates. The numerator for these rates was the count of crimes in that community area during the 12-month period and the denominator was the total population of the community area based on the 2010 U.S. Census. This rate was then multiplied by 1,000 to reflect rates per 1,000 persons. Crime rates were then standardized by subtracting the mean crime rate across all patients and dividing by the standard deviation to enable comparison of associations across different crime categories. We assessed sensitivity to choice of neighborhood definition by alternatively examining crime rates at the census tract level.

Covariates

Patient covariates were extracted from electronic health records and included potential confounders of the crime-adverse pregnancy outcomes relationship selected a priori. Maternal characteristics included age at delivery, race/ethnicity (Black/African American, White, Hispanic/Latino, Asian/Pacific Islander, other race, unknown), insurance status (public, private, none), multiparity (multiparous vs not), prevalent diagnosis of hypertension or diabetes, gestational diabetes during current pregnancy, history of asthma, history of mental health issue, history of a sexually transmitted disease, and history of substance abuse (including alcohol and tobacco use during current pregnancy). Infant sex was also recorded. Neighborhood poverty was defined as percent of population of the census tract in which a women resided that had household incomes below the poverty line based on data from the 2009-2013 American Community Survey.

Statistical Analysis

Distributions of birth outcomes, neighborhood crime rates, and covariates were examined in the study sample using means and standard deviations for continuous variables and proportions for categorical variables. We compared the distribution of covariates and outcomes among women by tertile of total neighborhood crime rate. We then used multilevel logistic regression with community area random intercepts to calculate adjusted odds ratios of the three adverse pregnancy outcomes associated with a 1-standard deviation increase in neighborhood crime rates. First, we ran an unconditional model to estimate the interclass correlation coefficient, or the proportion of the variance in each adverse pregnancy outcome

attributable to differences across community areas. Then, we ran the model with the neighborhood crime term and individual-level (level 1) and neighborhood-level (level 2) covariates. Models controlled for maternal age at delivery, race/ethnicity, insurance status, multiparity, prevalent hypertension, prevalent diabetes, history of asthma, mental health conditions, sexually transmitted disease, or substance abuse, gestational diabetes in current pregnancy, infant sex, and neighborhood poverty. We examined associations of total neighborhood crime rate, and then examined associations of rates of the four crime categories (homicide, assault/battery, criminal offenses, incivilities) to see if associations differed by crime type.

We conducted several sensitivity analyses. As some studies have found ambient temperature or season to be associated with adverse pregnancy outcomes,[36] we conducted a sensitivity analysis adjusting all models for season of delivery. In addition, we tested sensitivity to fixed-cohort bias, a type of selection bias occurring in retrospective studies of pregnancy outcomes in which shorter pregnancies are missed early in the study and longer pregnancies are missed at the end of the study.[37] As such, we excluded participants with an estimated date of conception at least 20 weeks before the study start (January 1, 2009) or within 43 weeks of the study end (December 31, 2013) to make the distribution of gestational age consistent across calendar time (N=3,254 births excluded).

RESULTS

During the study period, there were 34,383 singleton births. The number of births per community area ranged from 7 to 3,461 (median 163). Table 1 displays the distribution of past-year neighborhood crime rates in the community areas patients resided in. Past-year total crime rates ranged from 11.6 to 303.5 per 1,000 persons (mean: 61.5, standard deviation: 40.3, Table 1). The mean rates per 1,000 persons for specific crime categories were: homicide: 0.1 (SD: 0.1); assault/battery: 23.7 (SD: 16.5); criminal offenses: 14.3 (SD: 7.4); and incivilities: 23.4 (SD: 17.9). The distributions of neighborhood crime rates by adverse pregnancy outcome status are presented in Supplemental Table 2.

Available demographic and clinical characteristics of the study population are shown in Table 2. The mean age at delivery was 31.1 years. Half (49.6%) of women were White, 18.0% were Hispanic/Latina, 11.0% were Black/African American, 6.8% were Asian/Pacific Islander, 4.7% were classified as other race, and race/ethnicity was unknown for 9.9%. Most (76.6%) had private insurance, and 35.7% were multiparous. The average neighborhood poverty level was 17.3%. The prevalence of adverse pregnancy outcomes was 5.1% for hypertensive disease of pregnancy, 8.1% for preterm birth (5.5% for spontaneous preterm birth), and 10.5% for SGA.

We compared demographic and clinical characteristics among patients in each tertile of total neighborhood crime rate (Table 2). Women in highest crime neighborhoods were slightly younger on average, were more likely to be Black/African American, have public insurance, be multiparous, have a recorded history of asthma, a sexually transmitted disease, or substance abuse, have prevalent hypertension, and live in census tracts with a higher percent of population below the poverty line. Women in the highest crime neighborhoods were less

likely to have a recorded history of a mental health condition. Women in the middle tertile were more likely to have gestational diabetes in the current pregnancy and more likely to be Hispanic/Latina than those in the other tertiles. The proportion with adverse pregnancy outcomes increased with increasing tertile of neighborhood crime (hypertensive disease of pregnancy from 4.3% to 5.8%, preterm birth from 7.4% to 9.6%, and SGA from 9.4% to 11.5%, Table 2). Table 3 displays bivariate associations of demographic and clinical characteristics with each adverse pregnancy outcome.

In the unconditional models, intraclass correlation coefficients for the adverse pregnancy outcomes ranged from 3-5%. In multivariable models, a 1-standard deviation increase in total neighborhood crime rate was associated with a 6% increase in the odds of hypertensive disease of pregnancy (OR: 1.06, 95% CI: 1.00, 1.13), a 9% increase in the odds of preterm birth (OR: 1.09, 95% CI: 1.03, 1.15) and of spontaneous preterm birth (OR: 1.09, 95% CI: 1.03, 1.16), and a 5% increase in the odds of SGA (OR: 1.05, 95% CI: 1.01, 1.10) (Table 4). When we examined associations for specific types of crimes, we found that patterns were generally consistent across crime categories (Table 4), although incivilities had the largest association for three out of four outcomes (hypertensive disease of pregnancy, preterm birth, and spontaneous preterm birth). For hypertensive disease of pregnancy, the magnitude of association was small and confidence intervals crossed the null for homicide and criminal offenses. Results were similar in sensitivity analyses when an alternative neighborhood definition (census tract) was used, although slightly attenuated for hypertensive disease of pregnancy and SGA (Supplemental Table 3). Results were also similar upon adjustment for season of delivery (Supplemental Table 4), and were slightly stronger for preterm birth and hypertensive disease of pregnancy when we assessed sensitivity to fixed-cohort bias by excluding participants with dates of conception at least 20 weeks prior to the study start and within 43 weeks of the study end (Supplemental Table 5).

DISCUSSION

Higher neighborhood crime rates were associated with significantly higher odds of hypertensive disease of pregnancy, preterm birth (any or spontaneous), and small for gestational age among a large cohort of women in Chicago after adjustment for available maternal and infant demographics, clinical characteristics, and neighborhood poverty. When we examined associations of specific categories of crimes (homicide, assault/battery, criminal offenses, and incivilities), patterns were generally consistent across crime categories, although only assault/battery and incivilities were associated with hypertensive disease of pregnancy.

Our findings are consistent with several prior studies that found higher crime rates to be associated with higher risk of preterm birth[21, 26, 27] and low birthweight or SGA.[14, 15, 21, 24-26] While there was substantial heterogeneity in how crime was parameterized in prior studies, the effect sizes in our study were generally consistent with prior findings. For example, Morenoff et al found higher violent crime rates in Chicago to be associated with a 5% increase in odds of low birth weight,[15] and Masi et al found similar associations for SGA (OR 1.1-1.2 across race/ethnic groups upon adjustment for neighborhood economic disadvantage, also in Chicago).[14] Larger effect sizes were seen in several studies in North

Carolina[26, 27] that compared highest to lowest quartiles of violent crime rate. For example, women in neighborhoods in the two highest quartiles of violent crime had 1.5 times the odds of preterm birth (95% CI: 0.9-2.6) for white women and 1.4 times the odds of preterm birth (95% CI: 1.0, 2.1) for black women compared to those living in lower crime neighborhoods.[27] Prior studies were not able to adjust for maternal conditions such as prevalent hypertension, diabetes, or asthma that might be risk factors for adverse pregnancy outcomes due to lack of availability of this information in birth records.

The mechanisms through which neighborhood crime influences development of adverse pregnancy outcomes are not explicitly known, but may operate through multiple pathways. Crime may influence pregnancy outcomes through a direct biological pathway in which crime increases maternal physiological distress/chronic stress,[16, 17] leading to hormonal and neuroendocrine changes such as higher levels of corticotropin-releasing hormone and cortisol that may trigger spontaneous preterm birth or fetal growth restriction.[18, 19] In addition, neighborhood crime may make women less likely to engage in physical activity[22] or walking in their neighborhoods.[34] As obesity is an important risk factor for hypertensive disease in pregnancy,[38] crime may influence this outcome and, subsequently, downstream birth outcomes (preterm birth and SGA), through health behaviors. Crime may also lead women to adopt unhealthy behaviors such as smoking and drinking alcohol during pregnancy as a coping mechanism.[20, 21]

The positive association between neighborhood crime rates and hypertensive disease of pregnancy is a novel finding. While researchers have previously found that neighborhood physical degradation/disorder like litter, graffiti, and poor housing conditions was associated with hypertensive disease of pregnancy,[39, 40] and hypertension was previously included in an aggregate measure of pregnancy complications,[41] to our knowledge the association of neighborhood crime with hypertensive disease of pregnancy alone has not been examined. Hypertensive disease of pregnancy increases the risk of SGA and preterm birth, but is also an important outcome on its own given its links to future cardiovascular disease among affected women.[5, 6, 8]

Our finding that only incivilities and assault/battery were significantly associated with hypertensive disease of pregnancy may be a result of the relatively higher rates of these crime categories compared to homicide and criminal offenses. However, it is also possible that incivilities, which includes crimes such as vandalism and prostitution that are related to physical and social disorder in the neighborhood,[35] is a particularly salient neighborhood feature for adverse pregnancy outcomes, as the strongest association was observed for this crime category for three out of four outcomes. Proliferation of incivilities causes residents of a neighborhood to perceive greater problems and to lose confidence in their neighborhood and in police ability to prevent or control crime.[35] It is possible that incivilities may be particularly relevant for determining how individuals perceive the safety of their neighborhood, as physical and social disorder may be more readily apparent on a daily basis than less frequent crimes like homicide. Prior research has shown physical disorder to be associated with hypertensive disease of pregnancy[39, 40]. In addition, incivilities-related crime rates have been associated with lower odds of walking for transportation.[22] As physical activity may reduce the risk of developing hypertensive disease of pregnancy,[23]

incivilities may be particularly important for this outcome relative to more serious crimes like homicide.

Our use of electronic health record data is a strength of this study, as birth records may not reliably capture hypertensive disease of pregnancy, as well as several covariates for which we controlled. In addition, although our study population included women who sought care at a single academic hospital, we included a large, racially/ethnically diverse group of women from all 77 Chicago community areas, which may increase the generalizability of our findings. Our study was also subject to several limitations. First, we relied upon police-recorded crime, which likely does not capture all crime incidents. Crimes may be differentially reported by neighborhood due to differential police responses, which could lead to measurement error. In addition, we focused on objectively-measured crime only and were unable to determine whether women perceived their neighborhoods to be safe or unsafe. In addition, while EHR data may provide improved capture of pregnancy complications and medical history relative to birth records, it still may not have perfect capture of all data as these systems were designed for clinical practice rather than research. We lacked information on health behaviors like diet and physical activity that are likely mediators of the crime-pregnancy outcome relationship, as these behaviors were not routinely captured in the EHR. In addition, pre-pregnancy body mass index (BMI) was not captured consistently in the EHR, and gestational weight gain was missing for approximately 49% of our study population. Also, implausible/impossible values entered into the EHR for gestational age and birth weight resulted in missing data for preterm birth and SGA. In addition, we controlled for reported history of substance abuse, but this variable may have been misreported due to social desirability or recall bias, and did not distinguish between use during the current pregnancy and prior use. In addition, we lacked information on residential mobility and date of diagnosis of hypertensive disease of pregnancy. Finally, community areas may not accurately capture each woman's definition of her "neighborhood." However, results were generally consistent in a sensitivity analyses using census tract as an alternative neighborhood definition.

CONCLUSION

Higher neighborhood crime rates were associated with small but significant increases in the odds of four adverse pregnancy outcomes- hypertensive disease of pregnancy, preterm birth, spontaneous preterm birth, and small for gestational age. Interventions that promote safer neighborhoods and crime prevention may be a promising approach for reducing rates of adverse pregnancy outcomes among women living in urban areas.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements:

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What is already known on this subject?

Neighborhood exposures such as low socioeconomic status have been linked to adverse pregnancy outcomes. Neighborhood crime rates may contribute to these adverse outcomes by increasing mothers' levels of chronic stress, yet relatively few studies have examined these associations, particularly for the outcome of hypertensive disease of pregnancy.

What This Study Adds?

Using electronic health record data, we found neighborhood crime rates to be associated with higher odds of hypertensive disease of pregnancy, preterm birth (overall, and spontaneous), and small for gestational age birth.

Table 1.

Neighborhood Crime Rates Per 1000 Persons per Year- Total Crime and Specific Categories (N=34,383 births, Chicago, IL, 2009-2013)[1,2,3]

	Mean (SD)	Median	Range	IQR
Total Crime Rate	61.5 (40.3)	48.6	11.6-303.5	35.5-69.1
Homicide	0.09 (0.13)	0.04	0.00-1.71	0.02-0.10
Assault and Battery	23.7 (16.5)	19.6	3.4-133.1	12.7-25.2
Criminal Offenses	14.3 (7.4)	12.3	1.4-66.8	9.7-16.8
Incivilities	23.4 (17.9)	18.3	4.2-160.2	12.9-25.6

SD=standard deviation; IQR=interquartile range

[1] Neighborhood was defined as the Chicago Community Area (n=77) of residence during pregnancy.

[2] Crime rates were calculated for each birth by totaling the number of crime incidents in their neighborhood in the 12 months preceding the birth, dividing by the community area population as of the 2010 American Community Survey, and multiplying by 1,000

[3] Crimes were categorized as: homicide, assault and battery, criminal offenses (e.g. robbery, sexual assault, arson), and incivilities (e.g. drugs, prostitution, vandalism using the Illinois Uniform Crime Reporting codes.

Table 2.

Characteristics of the Study Sample, Overall and by Tertile of Neighborhood Crime Rate (N=34,383 births, Chicago, IL, 2009-2013)[1,2]

| | | Total Neighborhood Crime Rate | | |
	Overall	Tertile 1 (Low Crime)	Tertile 2 (Medium Crime)	Tertile 3 (High Crime)
N	34383	11345	11690	11348
Mother's Age at Delivery- Mean (SD)	31.1 (5.4)	32.5 (4.6)	30.7 (5.6)	30.0 (5.8)
Race				
White	17063 (49.6)	7669 (67.6)	5246 (44.9)	4148 (36.6)
Hispanic/Latino	6193 (18.0)	1002 (8.8)	3235 (27.7)	1956 (17.2)
Black/African American	3792 (11.0)	316 (2.8)	621 (5.3)	2855 (25.2)
Asian/Pacific Islander	2338 (6.8)	705 (6.2)	893 (7.6)	740 (6.5)
Other Race	1600 (4.7)	457 (4.0)	582 (5.0)	561 (4.9)
Unknown Race	3397 (9.9)	1196 (10.6)	1113 (9.5)	1088 (9.6)
Insurance Status				
Private	26344 (76.6)	10345 (91.2)	8350 (71.4)	7649 (67.4)
Public	7825 (22.8)	950 (8.4)	3261 (27.9)	3614 (31.8)
None	214 (0.6)	50 (0.4)	79 (0.7)	85 (0.8)
Multiparous	12285 (35.7)	3723 (32.8)	4241 (36.3)	4321 (38.1)
History of Asthma	3236 (9.4)	1013 (8.9)	1042 (8.9)	1181 (10.4)
History of Mental Health Condition	2758 (8.0)	1002 (8.8)	1012 (8.7)	744 (6.6)
History of Sexually Transmitted Disease	3924 (11.4)	1261 (11.1)	1280 (11.0)	1383 (12.2)
History of Substance Abuse[3]	683 (2.0)	137 (1.2)	214 (1.8)	332 (2.9)
Prevalent Hypertension	408 (1.2)	97 (0.9)	131 (1.1)	180 (1.6)
Prevalent Diabetes	305 (0.9)	85 (0.8)	110 (0.9)	110 (1.0)
Gestational Diabetes[4]	1596 (4.6)	429 (3.8)	646 (5.5)	521 (5.0)
Infant Sex				
Male	17543 (51.0)	5751 (50.7)	6003 (51.4)	5789 (51.0)
Female	16840 (49.0)	5594 (49.3)	5687 (48.6)	5559 (49.0)
Percent of census tract below poverty level- Mean (SD)[5]	17.3 (11.4)	11.6 (6.5)	17.9 (10.7)	22.5 (13.2)
Pregnancy Outcomes[6]				
Hypertensive Disease of Pregnancy	1748 (5.1)	485 (4.3)	605 (5.2)	658 (5.8)
Preterm Birth	2767 (8.1)	831 (7.4)	849 (7.3)	1087 (9.6)
Spontaneous	1884 (5.5)	583 (5.2)	579 (5.0)	722 (6.4)
Induced	883 (2.6)	248 (2.2)	270 (2.3)	365 (3.2)
Small for Gestational Age	3573 (10.5)	1055 (9.4)	1223 (10.5)	1295 (11.5)

[1] Values are N (%) unless otherwise specified. All demographic/clinical data extracted from electronic medical records.

[2] Total neighborhood crime rate indicates the total number of crime incidents in the year preceding each birth in the mother's community area of residence per 1000 persons in the community area. Total crime rate was categorized into tertiles for descriptive analyses.

[3] Including alcohol and tobacco use during current pregnancy

[4] In current pregnancy

[5] Based on the 2009-2013 American Community Survey.

[6] Hypertensive disease of pregnancy includes preeclampsia and gestational hypertension. Preterm birth was defined as <37 weeks. Small for gestational age was defined as <10th percentile birthweight for gestational age.

Table 3.

Characteristics of the Study Sample by Adverse Pregnancy Outcome Status (N=34,383 births Chicago IL, 2009-2013)[1]

	Hypertensive Disease of Pregnancy		Preterm Birth		Small for Gestational Age	
	Yes	No	Yes	No	Yes	No
N	1748	32635	2767	31484	3573	30554
Mother's Age at Delivery- Mean (SD)	31.0 (6.2)	31.1 (5.4)	30.7 (6.1)	31.1 (5.4)	30.3 (5.8)	31.2 (5.4)
Race						
White	776 (44.4)	16287 (49.9)	1120 (40.5)	15886 (50.5)	1370 (38.3)	15582 (51.0)
Hispanic/Latino	318 (18.2)	5875 (18.0)	513 (18.5)	5647 (17.9)	606 (17.0)	5536 (18.1)
Black/African American	343 (19.6)	3449 (10.6)	548 (19.8)	3228 (10.2)	615 (17.2)	3131 (10.2)
Asian/Pacific Islander	66 (3.8)	2272 (7.0)	159 (5.8)	2170 (6.9)	362 (10.1)	1961 (6.4)
Other Race	93 (5.3)	1507 (4.6)	148 (5.3)	1445 (4.6)	195 (5.5)	1394 (4.6)
Unknown Race	152 (8.7)	3245 (9.9)	279 (10.1)	3108 (9.9)	425 (11.9)	2950 (9.7)
Insurance Status						
Private	1232 (70.5)	25112 (77.0)	1932 (69.8)	24312 (77.2)	2565 (71.8)	23593 (77.2)
Public	509 (29.1)	7316 (22.4)	817 (29.5)	6976 (22.2)	987 (27.6)	6769 (22.2)
None	7 (0.4)	207 (0.6)	18 (0.7)	196 (0.6)	21 (0.6)	192 (0.6)
Multiparous	516 (29.5)	11769 (36.1)	1011 (36.5)	11216 (35.6)	930 (26.0)	11251 (36.8)
History of Asthma	213 (12.2)	3023 (9.3)	330 (11.9)	2895 (9.2)	341 (9.5)	2872 (9.4)
History of Mental Health Condition	170 (9.7)	2588 (7.9)	272 (9.8)	2472 (7.9)	270 (7.6)	2463 (8.1)
History of Sexually Transmitted Disease	196 (11.2)	3728 (11.4)	349 (12.6)	3559 (11.3)	425 (11.9)	3468 (11.4)
History of Substance Abuse[2]	41 (2.4)	642 (2.0)	103 (3.8)	574 (1.8)	115 (3.2)	559 (1.8)
Prevalent Hypertension	147 (8.4)	261 (0.8)	112 (4.1)	292 (0.9)	55 (1.5)	347 (1.1)
Prevalent Diabetes	52 (3.0)	253 (0.8)	58 (2.1)	245 (0.8)	23 (0.6)	279 (0.9)
Gestational Diabetes[3]	180 (10.3)	1416 (4.3)	223 (8.1)	1364 (4.3)	158 (4.4)	1427 (4.7)
Infant Sex						
Male	876 (50.1)	16667 (51.1)	1518 (54.9)	15963 (50.7)	1815 (50.8)	15595 (51.0)
Female	872 (49.9)	15968 (48.9)	1249 (45.1)	15521 (49.3)	1758 (49.2)	14959 (49.0)
Percent of census tract below poverty level- Mean (SD)[4]	19.3 (12.7)	17.2 (11.3)	19.5 (12.7)	17.1 (11.3)	18.5 (12.1)	17.2 (11.3)

[1] Values are N (%) unless otherwise specified. All demographic/clinical data extracted from electronic medical records.

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Table 4.

Associations of Neighborhood Crime Rates (Total and by Crime Category) with Adverse Pregnancy Outcomes (N=34,383 births, Chicago, IL, 2009-2013)[1,2,3,4,5]

	Hypertensive Disease of Pregnancy	Preterm Birth-All	Preterm Birth-Spontaneous	Small for Gestational Age
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Total Crime Rate	1.06 (1.00, 1.13)	1.09 (1.03, 1.15)	1.09 (1.03, 1.16)	1.05 (1.01, 1.10)
Crime Categories				
Homicide	1.02 (0.96, 1.08)	1.04 (0.99, 1.10)	1.05 (0.99, 1.11)	1.04 (0.99, 1.08)
Assault/Battery	1.06 (1.00, 1.13)	1.07 (1.01, 1.13)	1.08 (1.01, 1.15)	1.06 (1.01, 1.11)
Criminal Offenses	1.01 (0.95, 1.08)	1.07 (1.01, 1.13)	1.07 (1.01, 1.13)	1.06 (1.02, 1.11)
Incivilities	1.07 (1.01, 1.14)	1.10 (1.04, 1.16)	1.11 (1.04, 1.17)	1.04 (0.99, 1.09)

OR=odds ratio; CI=confidence interval

[1] Neighborhood was defined as the Chicago community area (n=77) of residence during pregnancy.

[2] Crime rates indicate the total number of crime incidents in the year preceding each birth in the mother's community area of residence per 1000 persons in the community area

[3] Results are from multilevel logistic regression models with a random intercept for community area (neighborhood). Odds ratios reflect the relative increase in odds of adverse pregnancy outcomes with each standard deviation increase in neighborhood crime rate

[4] Models were adjusted for maternal age at delivery, race/ethnicity, insurance status, multiparity, gestational diabetes, prevalent hypertension, prevalent diabetes, history of: asthma, mental health condition, sexually transmitted disease, or substance abuse; infant sex, and census tract-level percent of population with household incomes below the poverty line.

[5] N varied by model. Hypertensive disease of pregnancy: N=34,383; Preterm birth: N=34,251; Small for gestational age: N=34,127