
Gentrification and Preterm Birth in New York City, 2008–2010

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ABSTRACT *Adverse birth outcomes have been linked to neighborhood level socioeconomic status. However, little work has examined the influence of social and economic change over time (i.e., gentrification) on health. This study aims to assess the association between gentrification and preterm birth (PTB) while examining the modifying effect of maternal race/ethnicity and educational attainment. New York City births, 2008–2010, (n=126,165) were linked to a measure of gentrification at the community district level (n=59). The gentrification measure was calculated using percent change in education level, poverty level, and median household income (MHI) between the 2005–2009 American Community Survey and the 1990 Census. PTB was defined as clinical gestational age less than 37 weeks. Generalized estimating equations were utilized to examine the association. Gentrification (i.e., increase in residents with a college education, increase in MHI, and decrease in residents living below the poverty line) was not associated with PTB. However, among Non-Hispanic Blacks, very high gentrification was adversely associated with PTB (AOR, 1.16; 95 % CI, 1.01–1.33) as compared to those who lived in a very low gentrified neighborhood. Among non-Hispanic Whites, living in a very high gentrified neighborhood was protective as compared to living in a very low gentrified neighborhood (AOR, 0.78; 95 % CI, 0.64–0.94). Although there is a need to develop a more nuanced measure of gentrification, these results indicate that changes in the economic character of a neighborhood may have a significant influence on birth outcomes.*

KEYWORDS *Gentrification, Preterm birth, Socio-economic status, Urban renewal*

BACKGROUND

Over time, researchers have acknowledged that health is affected by socioeconomic status not only at the individual level but also at the neighborhood level. A wide variety of health outcomes have been linked to neighborhood level socioeconomic status.^{1–4} Absolute measures of socioeconomic status, such as deprivation and median household income, as well as relative measures, such as income inequality, have been found to be associated with health, in particular, adverse birth outcomes.^{5–8} Infant mortality and preterm birth, a primary cause of infant mortality, has been linked to both individual and neighborhood socioeconomic status.^{9–12} Despite the comprehensive literature of the impact of socioeconomic status on preterm birth, little work has focused on the effect of economic change, particularly neighborhood economic transitions may have a significant influence on health.

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Neighborhoods are not static but dynamic entities that can experience change across a number of dimensions. Economic and social changes that are a result of an influx of higher income residents and housing investment are collectively referred to as gentrification.¹³ It is also characterized by the displacement of lower income residents as housing stock values rise.^{13,14} These changes may result in both positive and negative consequences on those original residents who remain in the neighborhood, as well as the incoming residents.^{14–17} Revitalization and reinvestment in housing and resources, as well as a broadening of the tax base, are a few of the positive consequences.^{14–16} However, gentrification is often associated with the forced displacement of long-term lower-income residents who can no longer afford to remain in the neighborhood which results in a change in the character of the neighborhood, as well as rendering some social networks obsolete.^{15,16}

The health implications of gentrification have not been explored comprehensively, despite the likelihood of its effect on neighborhood socio-economic status. As part of an analysis examining the effect of neighborhood socioeconomic status, Pickett et al. also assessed whether a change in the neighborhood socioeconomic status affected preterm birth. The authors utilized an absolute change in the proportion of adult male unemployment, black residents, and individuals under the poverty line between 1980 and 1990 as indicators of economic change; Pickett et al. found that the risk of preterm birth increased when there was increased unemployment of adult males.¹⁸

Because gentrification affects both material resources and psychosocial stress, there is likely not one pathway that leads to preterm birth but multiple pathways. The neo-material pathway suggests that health inequalities may result from a differential access to material resources and opportunities.^{4,19} The psychosocial pathway emphasizes that physiological stress resulting from the environment will adversely affect pregnancy outcomes.^{20–22}

The current analysis was performed primarily to assess the association between gentrification and preterm birth in a population-based sample of births in New York City. A preliminary measure of gentrification was developed to characterize neighborhood economic change. Second, we examined if the association remained significant following the inclusion of maternal race/ethnicity and educational attainment, a proxy measure for individual socio-economic status.

MATERIALS AND METHODS

Study Design and Sample

We utilized birth certificate data from the New York City Department of Health and Mental Hygiene for 2008–2010 ($n=348,586$). Maternal demographics (i.e., race/ethnicity, age, educational status, and community district) and maternal and infant variables (i.e., parity, gestational age, and congenital anomalies) were obtained from these vital records. The analysis excluded women aged 19 or less ($n=23,031$), multiple births ($n=12,110$), multiparas ($n=177,583$), infants born with congenital anomalies ($n=4,960$), and non-specified other racial/ethnic group ($n=3,146$). Women aged less than 20 were excluded to ensure that the women had the opportunity to complete high school. Multiple births and those linked with congenital anomalies are at greater risk of preterm birth. Multiparas were excluded to remove the possibility of a prior adverse birth outcome. Women who were categorized as other for race/ethnicity were removed due to small sample size. Any records with incorrect community district identifiers ($n=1,556$) or incorrect/missing

clinical estimate of gestational age were also excluded from the sample (clinical gestational age less than 20 or greater than 45; $n=35$). The final sample size for the analysis was 126,165.

Birth Outcomes

Preterm birth (PTB) was defined as less than 37 weeks based on the clinical estimate of gestation recorded on the birth certificate.

Primary Exposure and Selected Covariates

To estimate a change in the economic status for each community district, the authors utilized Census data from 1990 and the 2005–2009 5-year estimate of the American Community Survey. There are 59 community districts in New York City ranging in population between 35,000 and 200,000 and in size between 900 acres and 15,000 acres.²³ Community districts are governed by a community board whose responsibilities include addressing land use and zoning issues, determining the needs of the community and attending to community issues.²⁴ Three variables were chosen to construct the measure: number of college or more educated adults aged 25 or more, number of residents living below the federal poverty line, and the median household income (MHI). A percent change was calculated for all three variables between the 1990 and 2005/2009 estimates. The 1990 MHI was adjusted for inflation utilizing the Consumer Price Index prior to calculating the percent change. z -scores were calculated for each of the three Census variables and then summed. The z -score ranged from -4.3 to 6.6 where lower z -scores corresponded to less gentrification. A five-level variable was constructed using quintiles (very high, high, medium, low, and very low). Very high gentrification was designated as those neighborhoods with a substantial increase in residents with a college education and MHI and a substantial decrease in poverty level. Very low gentrification indicated neighborhoods that had a slight increase or decrease in college-educated residents, MHI, and poverty level.

Selected Covariates

The covariates of interest, maternal race/ethnicity and educational attainment, were obtained from birth certificates. Maternal race/ethnicity was categorized as non-Hispanic White, non-Hispanic Black, Hispanic, and non-Hispanic Asian/Pacific Islanders (API). Maternal education was measured as years of education attained and was categorized as <12 years (less than high school), completing 12 years (high school), 13–15 years (some college), and ≥ 16 years (college or more).

Other individual level covariates included maternal age, Medicaid status, and marital status. In addition, neighborhood level covariates were included in the analysis to measure past neighborhood socioeconomic status (MHI in 1990) and adjust for population changes between 1990 and 2005/2009 (percent change in total population).

Statistical Analyses

The sample was characterized using descriptive statistics. To examine whether maternal race/ethnicity or education modified the relationship between gentrification and the birth outcome, the trends in the outcomes by quintiles of the gentrification measure were evaluated overall and stratified by race/ethnicity and education. To determine if there were significant trends we employed the Cochran–Armitage trend test. Due to the clustered nature of the data, generalized estimating equation

modeling was utilized to account for any correlation between observations within the community districts. We used the GENMOD procedure and the REPEATED option with binomial distribution and log link (SAS version 9.2, Cary, NC). Two-way interaction terms were tested to examine if maternal race/ethnicity and/or maternal educational status were acting as effect modifiers.

RESULTS

Maternal demographic and pregnancy characteristics are shown in Table 1 stratified by maternal race/ethnicity. Minority births account for almost 70 % of the sample. Non-Hispanic Black and Hispanic mothers are more likely to be younger and less likely to have a college or more education. They are also less likely to be married as compared to non-Hispanic White and API mothers. Overall, approximately 18 % of the sample resides in a community district designated as very high gentrification. Across racial/ethnic groups, non-Hispanic API were less likely to reside in a very high gentrified neighborhood.

The distribution of gentrification by community district has been overlaid with the prevalence rate of preterm birth for each community district in Fig. 1. The community districts identified as very high gentrification using the calculated metric correspond to areas that are anecdotally considered to be gentrified, such as East and Central Harlem, Park Slope, and the Lower East Side. The higher rates of preterm birth to some degree are in the neighborhoods designated as high gentrification.

Figures 2 and 3 illustrate the prevalence of preterm birth by gentrification and maternal race/ethnicity (Fig. 2) and maternal educational attainment (Fig. 3). In the overall sample, the prevalence of preterm birth is 7.3 %. The prevalence of preterm birth ranged from 5.1–10.9 % across racial/ethnic groups with non-Hispanic Blacks having the highest prevalence and non-Hispanic Whites with the lowest. In Fig. 2, a significant trend relationship across gentrification levels is shown for non-Hispanic Whites and Hispanics.

In Fig. 3, there is a significant trend across maternal education with the highest prevalence of preterm birth for those who did not complete high school (8 %) and the lowest prevalence in those with a college or more education (6.1 %). When examining the effect of gentrification within each educational strata, significant results are seen in all strata except for those who completed high school. In particular, for women with less than a high school education, the prevalence of preterm birth increases from 6.8 % in very low gentrification neighborhoods to 8 % in very high gentrification neighborhoods.

Crude and adjusted odds ratios for preterm birth are shown in Table 2. The interaction between gentrification and maternal race/ethnicity was significant allowing stratification. The adjusted model included maternal individual level covariates (maternal race/ethnicity, education, age, Medicaid status, and marital status) and the neighborhood level covariates (median household income in 1990 and percent change in the total population between 1990 and 2005/2009). In the overall sample, gentrification was not significant. However, when stratified by race/ethnicity, very high gentrification was significant for non-Hispanic Blacks in the fully adjusted model (AOR=1.16; 95 % CI 1.01–1.33). Very high gentrification was protective for non-Hispanic Whites (AOR=0.78; 95 % CI 0.64–0.94). Results for the analysis stratified by maternal education are not shown. Gentrification was not significantly associated with preterm birth in those stratified analysis.

TABLE 1 Demographic characteristics by race/ethnicity, New York City births 2008–2010

	Total (n = 126,165)		NH White (n = 41,835)		NH Black (n = 26,233)		Hispanic (n = 35,471)		NH Asian Pacific Islander (n = 22,426)	
	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent	Freq	Percent
Maternal age										
20–24	31,741	25.2	5,823	13.9	9,225	35.2	13,567	38.3	3,069	13.7
25–29	42,434	33.6	10,599	25.3	9,712	37.0	12,886	36.3	9,176	40.9
30–34	31,912	25.3	14,968	35.8	4,476	17.1	5,809	16.4	6,614	29.5
35+	20,078	15.9	10,445	25.0	2,820	10.8	3,209	9.1	3,567	15.9
Maternal education										
<12 years	19,491	15.5	1,664	4.0	3,806	14.6	9,068	25.6	4,929	22.0
12 years (HS)	24,780	19.7	5,117	12.3	6,867	26.3	8,986	25.4	3,785	16.9
13–15 years	31,282	24.9	6,817	16.3	9,679	37.1	11,097	31.3	3,641	16.3
16+ years	50,295	40.0	28,171	67.4	5,757	22.1	6,261	17.7	10,045	44.8
Marital status										
Married	71,171	56.4	35,373	84.6	7,102	27.1	11,277	31.8	17,326	77.3
Insurance status										
Medicaid	65,137	51.6	9,821	23.5	17,453	66.5	25,271	71.2	12,488	55.7
Gentrification										
Very high	22,870	18.1	7,886	18.9	4,949	18.9	6,977	19.7	3,012	13.4
High	21,770	17.3	6,257	15.0	4,993	19.0	7,847	22.1	2,633	11.7
Medium	31,791	25.2	13,039	31.2	5,812	22.2	7,523	21.2	5,371	24.0
Low	26,717	21.2	10,097	24.1	7,938	30.3	4,386	12.4	4,252	19.0
Very low	23,017	18.2	4,556	10.9	2,541	9.7	8,738	24.6	7,158	31.9

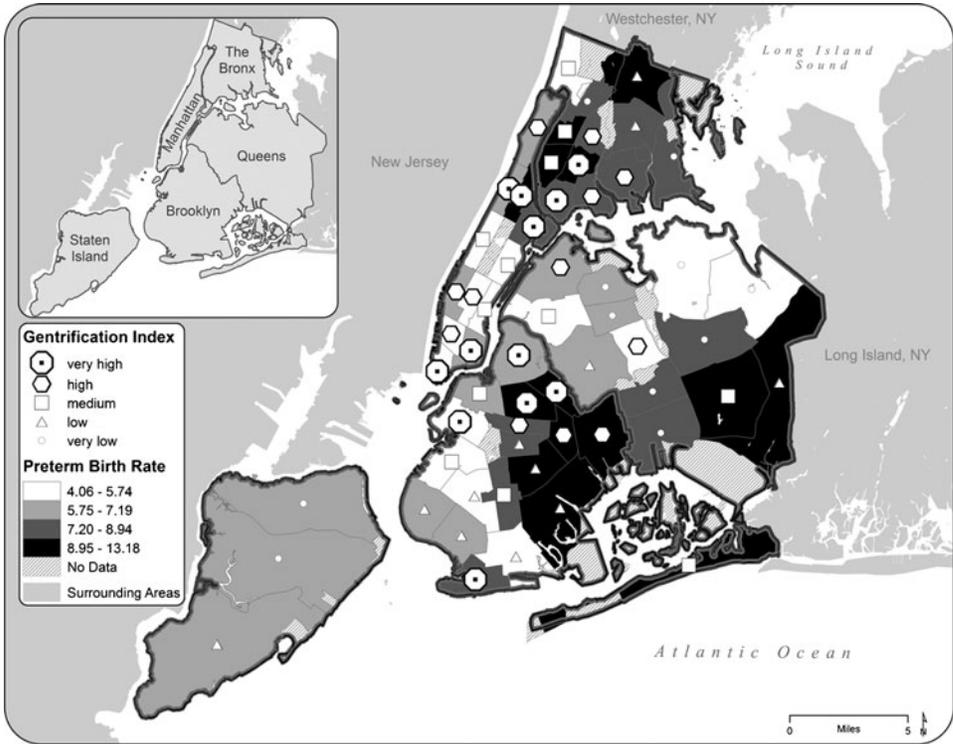
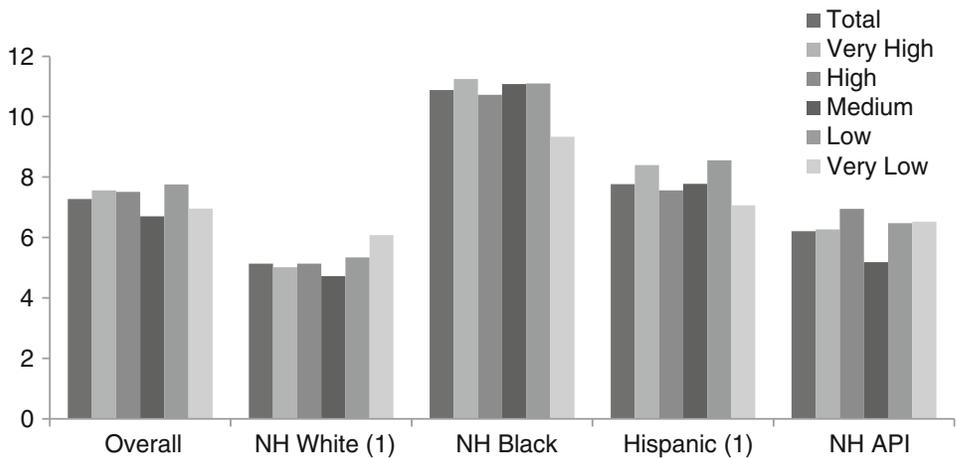


FIG. 1 Distribution of gentrification and preterm birth by community district, New York City births 2008–2010

DISCUSSION

For the overall sample, gentrification was not associated with preterm birth. However, when examined within maternal race/ethnicity, a modest relationship was maintained following inclusion of both individual and neighborhood level covari-



¹p<0.05
²p<0.0001

FIG. 2 Prevalence of preterm birth by gentrification and race/ethnicity, New York City births 2008–2010

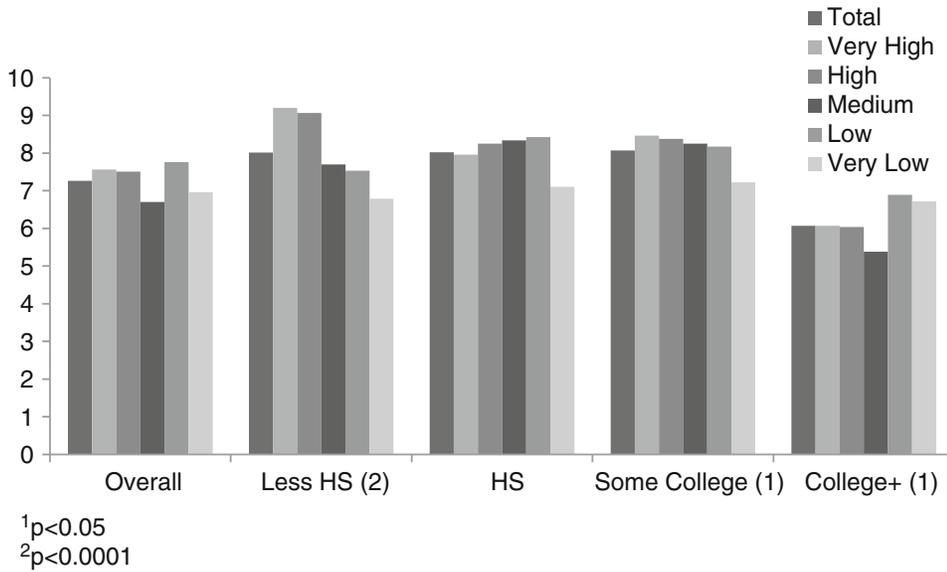


FIG. 3 Prevalence of preterm birth by gentrification and maternal education, New York City births 2008–2010

ates. Very high gentrification was adversely associated with preterm birth for non-Hispanic Blacks indicating a differential effect of gentrification by race/ethnicity. Whereas for non-Hispanic Whites, very high gentrification was protective in regards to preterm birth which may indicate that residing in a gentrifying neighborhood is beneficial as compared to a neighborhood that is not changing economically. This analysis may provide some evidence that neighborhood level economic transition may have a significant effect on preterm birth and its differential effect by maternal race/ethnicity.

The neo-material pathway may serve as a framework in understanding the impact of gentrification on birth outcomes. Investments by businesses in a gentrifying neighborhood can result in a wider range of resources for long-term residents. However, over time, these resources may become disproportionately expensive for lower-income residents. Conversely, the influx of new resources may occur over the span of years possibly resulting in fewer resources that new higher income residents may be accustomed. Like the neo-material pathway, the psychosocial stress pathway may illuminate the role of gentrification in adverse birth outcomes. The displacement of long-term residents can result in changes in the character of the neighborhood and a disruption of social networks. For new higher-income residents, stress can be a consequence of experiencing some level of a lack of social networks and of a wide array of resources. Conversely, by residing in a gentrifying neighborhood, new residents may be spending less of their resources on housing costs leading to an increase in disposable funds.

The authors identified several limitations to this analysis. It is unlikely that residents define their community using community district boundaries; however, when using Census data, researchers are restricted in their use of administrative areas with defined boundaries. However, community districts are used by the New York City government to change zoning regulations and designate funding for new housing developments. Another limitation was the broad characterization of

TABLE 2 Crude and adjusted odds ratios for preterm birth by gentrification and stratified by race/ethnicity, New York City births 2008–2010

	Crude		Adjusted model 1	
	OR	95 % CI	OR	95 % CI
Overall				
Very high	1.09	0.92–1.28	0.96	0.87–1.06
High	1.08	0.89–1.31	0.96	0.85–1.07
Medium	0.96	0.78–1.18	0.95	0.85–1.06
Low	1.12	0.93–1.34	1.07	0.97–1.19
Very low	Ref			
NH White				
Very high	0.82	0.70–0.96	0.78	0.64–0.94
High	0.84	0.71–1.00	0.82	0.69–0.98
Medium	0.78	0.68–0.88	0.82	0.69–0.96
Low	0.88	0.75–1.03	0.89	0.76–1.04
Very low	Ref			
NH Black				
Very high	1.21	1.06–1.37	1.16	1.01–1.33
High	1.15	0.96–1.37	1.09	0.92–1.28
Medium	1.19	1.04–1.36	1.12	0.98–1.27
Low	1.19	1.06–1.34	1.15	1.01–1.30
Very low	Ref			
Hispanic				
Very high	1.19	1.07–1.32	1.02	0.91–1.16
High	1.07	0.92–1.24	0.97	0.84–1.12
Medium	1.1	0.97–1.25	1.03	0.91–1.17
Low	1.21	1.07–1.37	1.22	1.07–1.39
Very low	Ref			
NH API				
Very high	0.96	0.73–1.26	0.86	0.68–1.08
High	1.06	0.84–1.35	0.97	0.77–1.22
Medium	0.79	0.61–1.04	0.78	0.60–1.02
Low	0.99	0.81–1.21	0.97	0.78–1.21
Very low	Ref			

Model adjusts for: maternal education, race/ethnicity, age, marital status, Medicaid status, 1990 MHI, and percent change in total population between 1990 and 2005/2009

gentrification as simply the economic and educational change in the population. Despite the lack of information on social changes, the community districts identified as very high gentrification by this preliminary measure do match anecdotal accounts of gentrification in New York City. Lastly, the primary limitation of this analysis is the lack of information regarding tenure resulting in an inability to distinguish between new and long-term residents. It was not possible to assess if gentrification affected new or long-term residents disproportionately. However, we hypothesized that both new and long-term residents may be both positively and negatively affected by gentrification.

The strengths of this analysis lie in the large and diverse sample size and the 15-year span to measure gentrification. We were able to examine the influence of gentrification across a number of strata with more than adequate power. In addition, the use of Census 1990 and ACS 2005–2009 5-year estimate spanned a significant period of time. Although we were unable to utilize Census 2010 data

(community district level data was not available), the use of the Census 1990 and ACS 2005–2009 5-year estimate provided comparable data.²⁵ The ACS 2005–2009 5-year estimate data provides robust estimates for small geographical areas. Finally, the analysis allowed us to incorporate both individual and neighborhood level covariates in the same model and adjusted for any intra-correlation.

Despite the above limitations, these results do indicate an association between gentrification and preterm birth and the need to further assess this relationship. In future work, other dimensions of gentrification need to be considered; in particular, assessing the social influence of gentrification would provide a more nuanced characterization of gentrification. Likewise, the incorporation of individual level data pertaining to length of tenure would provide a more in-depth assessment of the influence of gentrification. In addition, gentrification should be assessed on surrounding neighborhoods to determine if there is a wider effect. Due to the growing movement to invest in urban areas, it is vital to understand the possible health effects of gentrification.

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