



An Examination of Preterm Birth and Residential Social Context among Black Immigrant Women in California, 2007–2010

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Abstract

The foreign-born black population contributes a considerable amount of heterogeneity to the US black population. In 2005, black immigrants accounted for 20% of the US black population. Compared to native-born black women, black immigrant women are at lower risk for adverse birth outcomes, including preterm birth. Some scholars posit that differential exposures to socioeconomic disadvantage and structural racism in the residential context may account for this advantage. However, to date, few studies offer comprehensive examinations of the black immigrant residential social context, particularly in settlement regions beyond predominantly black and historically segregated regions. Further, studies examining the black immigrant residential context typically use a single indicator, which limits discussion of the intersecting domains that simultaneously increase or decrease risk among black immigrants. We addressed these gaps by examining black immigrant neighborhoods in the state of California, where racial residential segregation of the black population is low. We operationalized the residential context of black immigrant women using three distinct attributes: immigrant co-ethnic density, black racial concentration, and neighborhood deprivation. We linked 2007–2010 California birth records of black immigrant women and 2010 census data on tract-level social attributes ($N = 6930$). OLS regression analyses showed that immigrant co-ethnic density, black racial concentration and neighborhood deprivation were not associated with preterm birth among black immigrants. Our findings indicate that in California, residential social context has little relation to black immigrant preterm birth—a finding that is unique compared to residential settings of other settlement contexts.

Keywords Race · Nativity · Preterm birth · Neighborhoods

Introduction

Black immigrant women in the United States show at least a 30% lower risk of preterm birth (i.e., > 37 weeks gestation) compared to native-born black women [1, 2]. Comparisons of maternal characteristics between native- and foreign-born black women show that demographic characteristics, health behaviors and medical risk factors do not fully explain the lower risk among black immigrant women [2–5]. This has led some scholars to consider the role of neighborhoods, as black immigrants may have differential exposure to area-level risk and protective factors compared to their

native-born counterparts. Following a socio-ecological framework, we can expect that black immigrant birth outcomes are influenced by a convergence of multiple factors including maternal characteristics, neighborhood physical and social attributes and broader macro-level factors such as racism [6].

The study of black immigrant neighborhoods is complex, and the social context can be examined through several distinct domains. Black immigrant neighborhoods characterized by a high spatial concentration of black immigrants may have higher levels of neighborhood social capital and subsequent social connectedness [7]. But a parallel body of segregation literature suggests that black immigrants are often subject to racial discrimination in their daily encounters with individuals and social structures, just as their native-born counterparts [8, 9]. Yet this context of opposing domains in black immigrant neighborhoods is understudied, due to siloed bodies of literature on immigrant enclaves, residential segregation and neighborhood socioeconomic conditions.

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Furthermore, black immigrant neighborhoods in the Northeast are the focus of most studies but these neighborhoods are unique given the long history of black–white residential segregation that characterizes them. This narrow focus limits generalizability to other black immigrant settlement contexts without such a pervasive history of racial residential segregation.

The Residential Context of Black Immigrants

Neighborhood Immigrant Co-ethnic Density

Immigrant neighborhood research draws on theories such as the ethnic density hypothesis which posits that residing among co-ethnics promotes more favorable physical and mental health outcomes. Immigrant co-ethnic density then increases neighborhood social capital which buffers against the deleterious effects of material disadvantage, and limits exposure to stress-inducing discrimination [10–12]. Immigrant co-ethnic density is often used to assess whether foreign-born concentration in neighborhoods represents a protective factor stemming from voluntary settlement decisions that are based on shared ethnic culture and opportunity [13]. Studies that adopt this measure find protective associations between immigrant co-ethnic density and health in Hispanic and some Asian enclaves [11, 14]. Interestingly, for black immigrants the small body of literature reports living in neighborhoods with more black immigrants is associated with poorer birth outcomes. For instance, Mason et al. [15] found higher preterm birth risk in non-Hispanic black immigrant mothers as co-ethnic density increased in New York City. Janevic and colleagues [16] describe similar co-ethnic density trends for gestational diabetes risk in New York City among sub-Saharan African mothers, though the association for immigrant co-ethnic density was not significant. In a spatial analysis of Philadelphia neighborhoods, preterm births were more concentrated in areas of high foreign-born black density, unlike the patterns observed for non-Hispanic white density [17].

Studies of black immigrant birth outcomes and immigrant co-ethnic density of other racial/ethnic groups also highlight the distinct impact of black immigrant co-ethnic density. Mason and colleagues [18] found that black immigrant women residing in predominantly Hispanic neighborhoods had lower preterm birth risk compared to residence in black immigrant neighborhoods in New York City. And in New Jersey, Vang and Elo [19] showed that among black immigrants, residence in majority–minority neighborhoods increases infant birth weights. Thus, while immigrant co-ethnic density generally improves immigrant birth outcomes, black immigrant co-ethnic density appears to be an exception.

Racial Residential Segregation

Racial residential segregation of minorities describes the extent to which racial/ethnic minorities are involuntarily constrained to isolated communities with higher levels of socioeconomic disadvantage [20]. In spite of overall declines in racial residential segregation since 1980, the US black population still experiences the highest levels of segregation compared to all other racial/ethnic minority groups—an important factor working against immigrant co-ethnic density in black immigrant neighborhoods [21]. Despite carrying a foreign-born advantage and having lower exposure to lifelong minority status in the US, black immigrants remain a racialized group and experience similar race-related stressors to that of native-born blacks [22, 23].

For instance, a recent national study of residential segregation found that relative to native-born black women, black immigrant women are at similarly increased risk for preterm birth as residential segregation increases [24]. In New York City, Grady and McLafferty [25] found that among black immigrant women, low birth weight risk was 15% higher for those living in highly segregated areas, compared to their counterparts living in less segregated areas, and the magnitude of this difference was similar to that of native-born black women. However a study of racial residential segregation and black immigrant birth outcomes in the Midwest presents competing patterns and may indicate that the segregation patterns observed in the Northeast may differ in other settlement regions. In 2006, Baker and Hellerstedt found an increased risk for preterm birth among native-born blacks as black racial concentration increased but found no significant associations with black racial concentration among foreign-born black mothers in Minnesota [26]. While the study confirmed a nativity advantage after adjustment for maternal characteristics, no other area-level characteristics, like immigrant co-ethnic density, were included as possible explanations for the null association in that context.

The apparent deleterious impact of black immigrant co-ethnic density observed in Northeastern neighborhoods may relate to their location in segregated areas, such as New York City, which reflect a long history of black–white residential segregation in the US. For example, as Mary Waters [27] described in her qualitative study of West Indian immigrants in New York City, black immigrant neighborhoods are inescapably embedded in residential contexts burdened by or in close proximity to areas with high racial residential segregation. In her study, this co-location increased exposure to neighborhood violence and had negative impacts on the socioeconomic mobility, educational outcomes, and identity formation of black

immigrants and their children [27]. Compared to other racial/ethnic minority groups, the US black population experiences the highest levels of poverty and segregation from the US white population (across several segregation indices), and these trends are most prevalent in the Northeast [21]. Unlike Hispanic and Asian neighborhoods, black immigrant neighborhoods in the Northeast may be subject to patterns of social disadvantage that are akin to segregated black neighborhoods, where high levels of black–white segregation result in stress-inducing contexts [20].

Neighborhood Socioeconomic Conditions

Many of the studies discussed here adjust for neighborhood socioeconomic conditions as a potential confounder of the associations between neighborhood immigrant co-ethnic density and birth outcomes, and between residential segregation and birth outcomes [28]. However, much like the segregation literature, scholarship on neighborhood socioeconomic conditions rarely examine the simultaneous impact of immigrant co-ethnic density in black immigrant neighborhoods. For example, Fang and colleagues [29] found that black immigrant mothers had similar low birth weight outcomes compared to white mothers, but in low-income communities, black immigrants had significantly higher birth weights compared to white mothers in similar low-income communities in New York City. Grady and McLafferty [25] found similar patterns in their study of low birth weight and neighborhood poverty among native and foreign-born blacks. While socioeconomic conditions reflect the degree of material disadvantage in neighborhoods, these studies suggest that there may also be protective factors present that buffer against the deleterious impact of material disadvantage in black immigrant neighborhoods. However, since neither study included a measure of immigrant co-ethnic density as a covariate in black immigrant neighborhoods, it is unclear if psychosocial benefits resulting from the spatial concentration of black immigrants (i.e., immigrant co-ethnic density) explains these associations.

The Present Study

The studies reviewed here indicate that immigrant co-ethnic density, racial residential segregation and neighborhood socioeconomic conditions each have a distinct relationship with black immigrant preterm birth. Immigrant co-ethnic density appears to increase black immigrant preterm birth, but because many of these studies focus on racially segregated neighborhoods in the Northeast, they may indicate that the social and structural benefits of immigrant co-ethnic density are blunted by the concurrent concentration of poverty and social adversity characterizing racially segregated

black neighborhoods. Beyond this distinct context the balance of protective social characteristics and neighborhood socioeconomic conditions in black immigrant neighborhoods is unknown. We argue that beneficial immigrant co-ethnic density associations may be more pronounced in areas with lower black-white residential segregation, such as California. To test this, we examine black immigrant neighborhoods using three attributes: immigrant co-ethnic density, black racial concentration, and neighborhood deprivation. We begin the study with an analysis of each neighborhood attribute and the percentage of black immigrant preterm birth in California neighborhoods. We hypothesize that immigrant co-ethnic density is associated with lower preterm birth; black racial concentration is associated with higher preterm birth; and neighborhood deprivation is associated with higher preterm birth among infants born to black immigrant women. Lastly, we investigate the association between immigrant co-ethnic density and preterm birth after adjusting for black racial concentration and neighborhood deprivation, where we expect the negative association between immigrant co-ethnic density and preterm birth will be stronger after adjustment.

Methods

Data and Sample

In this study, we conducted an ecological analysis of births to foreign-born black mothers in urban California census tracts. We opted for an ecological analysis because of our exploratory interest in how each neighborhood attribute contributes to the black immigrant neighborhood context and preterm birth patterns. We used California birth records of black births (identified as birth to a mother who identified as “black”) occurring between 2007 and 2010. For each birth, we coded mothers as foreign-born if a mother’s birthplace was an African or a non-Hispanic Caribbean country. For Caribbean women, we did not include births to women from Hispanic countries as to not conflate the role of Hispanic origin with black immigrant co-ethnic density in these populations. Birth records were then geocoded in Geolytics software to 2010 California census tracts with mother’s residential address and zip code (Geolytics Inc, Brunswick, NJ). 94% of births were successfully geocoded ($N = 157, 266$), and the final sample included 9385 live singleton births to African-born mothers and 1324 live singleton births to Caribbean-born mothers between 18 and 54 years of age ($N = 10,705$). Births to mothers outside of this age range accounted for less than 1% of births.

We include urban census tracts as our unit of analysis. In 2010, California had a total of 8057 census tracts of which 7836 (97%) were urban. We excluded rural tracts because

they represent a qualitatively different settlement context for immigrants, and previous studies have only validated our exposure variables in urban settings. Census tract characteristics such as the proportion of foreign-born blacks were calculated using 2010 5-year American Community Survey (ACS) estimates of the foreign-born black population. 2010 ACS data were used to calculate neighborhood socioeconomic condition and total US black population by census tract. We linked California birth records of foreign-born black mothers to tract-level characteristics using census tract geographic identification numbers. The final tract-level dataset included all black immigrant births nested in 6946 urban tracts (where black immigrant births occurred) of which 6930 tracts had complete data for all three neighborhood attributes.

Measures

We included the tract-level percent of black immigrant births that were preterm as the outcome of interest. We defined a preterm birth as a live singleton birth with a gestation period of fewer than 37 weeks. The gestation period was based on clinical estimates of gestational age [30]. Given that neighborhood social context can be a source of psychosocial stress, we elected to study preterm birth based on evidence which links maternal stress during pregnancy as an independent risk factor for a premature birth [31–33].

We used tract-level census data to measure black immigrant co-ethnic density, which we defined as the proportion of foreign-born blacks per total tract population [11]. Immigrant co-ethnic density ranged from 0.02% foreign-born black to 18.2% foreign-born black, with a mean of 0.51% (SD = 1.02). Black immigrant co-ethnic density percentages were highly skewed; most tracts had less than 1% black immigrants. Following other studies with similar distributions, we categorized tracts in the highest quartile of immigrant densities as having the highest co-ethnic density, compared to all others which we coded as low co-ethnic density [16, 34].

Research finds that black racial concentration correlates with higher preterm birth risk among black women and it has previously been used as a proxy measure for black-white racial residential segregation [35]. Following previous studies of residential segregation and birth outcomes, we use tract-level black racial concentration as a proxy for formal segregation indices [26, 36, 37]. Other measures of racial segregation, such as residential isolation would require block-level information, which is not available in public-use ACS census data. We measured black racial concentration as the proportion of black residents (per total tract population) in each tract. Black racial concentration ranged from 0.4 to 87.2%, with an average of approximately 6.5% (SD = 9.9). We also dichotomized this variable using the same method

described for immigrant co-ethnic density, because most tracts had less than 2% black racial concentration.

We measured socioeconomic conditions using a standardized neighborhood deprivation index developed by Messer et al. [38] to account for the multidimensionality of neighborhood socioeconomic conditions. This index captured several socio-demographic domains (i.e., poverty, education, employment, housing, residential stability, and occupation) associated with birth outcomes and was validated in urban census tracts [38]. We used z-score standardization to standardize the index to have a mean of 0 and a standard deviation of 1. We interpret low values on the deprivation index as less deprived neighborhoods and higher values as a more deprived neighborhood. Standardized deprivation scores ranged from –2.4 to 5.3. This variable was also dichotomized for analysis.

Statistical Analysis

We used ordinary least squares (OLS) regression to estimate the association between each of the neighborhood attributes and the tract-level proportion of black immigrant preterm births. We ran two sets of regression models. In the first set, we regressed each neighborhood attribute on the percentage of black immigrant preterm births in tracts individually. In the second set of regressions, we examined the association between immigrant co-ethnic density and preterm birth, adjusting for black racial concentration and neighborhood deprivation. All neighborhood attributes were treated as dichotomous variables, though we ran a sensitivity analysis using continuous measures of each neighborhood attribute to confirm our findings. All analyses and variable constructions were completed using Stata 15.0 (College Station, TX).

Results

Descriptive Results

Table 1 describes the proportion of preterm birth among black immigrant mothers by each neighborhood attribute. We present the results using categories denoting neighborhoods that are in the highest quartile of each neighborhood attribute relative to all other neighborhoods. Overall, there was minimal variation in the proportion of black immigrant preterm births by neighborhood attribute and degree of exposure (i.e., highest quartile neighborhoods vs. all other neighborhoods). In neighborhoods with the highest immigrant co-ethnic density, about 7.6% of black immigrant births were preterm compared to 8.1% in lower co-ethnic density neighborhoods. Neighborhoods with the highest black racial concentration had a slightly lower percentage of black immigrant preterm birth compared to neighborhoods

Table 1 Distribution of tract-level preterm birth (percent) and total births among foreign-born black women and neighborhood attributes

Neighborhood attributes ^a	% Preterm births (foreign-born Black)	Foreign-born Black births	Tracts	Range ^c
Immigrant co-ethnic density				
Highest density neighborhoods	7.55	4650	1731	0.48–18.20
Lower density neighborhoods	8.09	6015	5199	0.02–0.47
Black racial concentration				
Highest concentration neighborhoods	7.54	4794	1735	7.69–87.17
Lower concentration neighborhoods	8.11	5871	5195	0.03–7.67
Neighborhood deprivation				
Highest deprivation neighborhoods	7.48	2927	1789	0.08–5.26
Lower deprivation neighborhoods	8.10	7792	5157	–2.41–0.07
Total	7.91	10,665	6930^b	

^aNeighborhoods with a proportion of foreign-born black mothers, black racial concentration, or neighborhood deprivation in the highest quartile. We classify all other tracts as lower density

^b16 tracts with incomplete neighborhood attribute data, also excluded 40 births that occurred in these tracts

^cAll ranges presented as percentages except for neighborhood deprivation which are standardized index scores

with lower black racial concentration (7.5% vs. 8.1%). Similar patterns were observed for neighborhoods with the highest neighborhood deprivation compared to neighborhoods with lower deprivation (7.5% vs. 8.1%).

Residential Context and Black Immigrant Preterm Birth

We examined the association between immigrant co-ethnic density, black racial concentration, neighborhood deprivation and black immigrant preterm birth (Table 2). Overall, the results suggest that there is no association between immigrant co-ethnic density, black racial concentration, neighborhood deprivation and the proportion of black immigrant preterm birth in California neighborhoods. For example, the immigrant co-ethnic density coefficient indicates that the proportion of preterm births did not differ significantly in neighborhoods with highest immigrant co-ethnic density compared to all other neighborhoods ($b = -0.005$; 95% CI

$-0.021, 0.011$). Similarly, the black racial concentration coefficient shows that the proportion of black immigrant preterm birth for neighborhoods with the highest black racial concentration is not significantly different from those with lower concentrations ($b = -0.006$; 95% CI $-0.021, 0.010$).

Lastly, we examined the association of immigrant co-ethnic density and black immigrant preterm birth adjusting for black racial concentration and neighborhood deprivation (Table 3). We present the regression results of immigrant co-ethnic density models first adjusting for black racial concentration (model 2), then neighborhood deprivation (model 3), and then both black racial concentration and neighborhood deprivation in a fully adjusted model (model 4). We include the unadjusted co-ethnic density model from Table 2 for reference (model 1). Overall, after individually adjusting for neighborhood deprivation and black concentration there were no significant associations between immigrant co-ethnic density and black immigrant preterm birth. For example, the immigrant co-ethnic density coefficient in

Table 2 Unadjusted OLS regression estimates for models of each neighborhood attribute and the tract-level preterm birth among foreign-born black women

Variable	Regression coefficient	Standard error	95% CI
Immigrant co-ethnic density			
Highest immigrant co-ethnic density	-0.005	0.008	-0.021, 0.011
Intercept	0.081	0.005	0.072, 0.090
Black racial concentration			
Highest black racial concentration	-0.006	0.008	-0.021, 0.010
Intercept	0.081	0.005	0.071, 0.090
Neighborhood deprivation			
Highest neighborhood deprivation	-0.006	0.009	-0.024, 0.011
Intercept	0.081	0.004	0.073, 0.089

CI Confidence Interval

Table 3 Unadjusted and adjusted linear regression estimates of immigrant co-ethnic density and tract-level preterm birth among foreign-born black women

Model	Regression coefficient	Standard error	95% CI
Model 1: Unadjusted			
Highest immigrant co-ethnic density	−0.006	0.008	−0.021, 0.011
Intercept	0.081	0.005	0.072, 0.090
Model 2: Adjusting for Black racial concentration			
Highest immigrant co-ethnic density	−0.004	0.009	−0.021, 0.013
Highest Black racial concentration	−0.004	0.009	−0.021, 0.012
Intercept	0.082	0.005	0.072, 0.092
Model 3: Adjusting for neighborhood deprivation			
Highest immigrant co-ethnic density	−0.005	0.008	−0.021, 0.011
Highest neighborhood deprivation	−0.005	0.009	−0.023, 0.012
Intercept	0.082	0.005	0.072, 0.092
Model 4: Fully adjusted			
Highest immigrant co-ethnic density	−0.004	0.009	−0.021, 0.013
Highest Black racial concentration	−0.003	0.009	−0.020, 0.014
Highest neighborhood deprivation	−0.004	0.009	−0.022, 0.013
Intercept	0.083	0.005	0.072, 0.093

CI confidence interval

model 2 shows that the difference in the proportion of black immigrant preterm births between neighborhoods with the highest immigrant co-ethnic density (with low black racial concentration) and low-density neighborhoods (with low black racial concentration) was not significant ($b = -0.004$; 95% CI $-0.021, 0.013$). Similarly, in model 3, the immigrant co-ethnic density coefficient shows that the difference in black immigrant preterm birth between highest co-ethnic density neighborhoods and low co-ethnic density when neighborhood deprivation is not significant ($b = -0.005$; 95% CI $-0.021, 0.011$). Compared to the unadjusted model, the magnitude of the immigrant co-ethnic density coefficient did not fluctuate between model 2, model 3 or model 4. These results suggest that immigrant co-ethnic density is not impacted by black racial concentration or neighborhood deprivation in California neighborhoods.

We conducted a set of sensitivity analyses using continuous neighborhood attributes and found similar results for each set of models (not included in tables). Unadjusted models for immigrant co-ethnic density, black racial concentration and neighborhood deprivation were not related to the proportion of black immigrant preterm births. We also found no significant associations in adjusted models. For example, after fully adjusting for black racial concentration and neighborhood deprivation, immigrant co-ethnic density was not related to black immigrant preterm birth. The direction of immigrant co-ethnic density and preterm birth associations differed in the models with dichotomous (negative association) versus continuous (positive association) variables. Upon visual inspection of the data, we identified a set of extreme outcomes ($n = 135$) relative to other tracts with

lower co-ethnic density (the proportion of preterm births excluding these observations was 7.1%). We confirmed that the extreme patterns were due to the tracts having only one black immigrant birth. We ran the dichotomous models without these extreme proportions, which corrected the discrepancy and returned a positive association (though not significant).

Discussion, Limitations and Future Directions

The purpose of this study was to describe the association between residential context and black immigrant preterm birth, using three distinct neighborhood attributes (immigrant co-ethnic density, black racial concentration, and neighborhood deprivation) which capture the dueling forces of foreign-born advantage and racial disadvantage in black immigrant enclaves. We tested the association between each neighborhood attribute and black immigrant preterm birth and then tested the association between immigrant co-ethnic density and black immigrant birth adjusting for black racial concentration and neighborhood deprivation. We found no significant associations between the neighborhood attributes and black immigrant preterm birth. We also found that adjusting for black racial concentration and neighborhood deprivation had little impact on the relationship between immigrant co-ethnic density and black immigrant preterm birth in California neighborhoods. Our null results contradict findings of positive associations between preterm birth risk and black immigrant enclaves in New York City,

highlighting the importance of geographic heterogeneity in black immigrant enclaves, which reflects variations in the social condition of black populations. Black immigrant enclaves in New York and other Northeastern locales are more likely to be situated in historically racially segregated neighborhoods compared to enclaves in California [15]. This distinction is important and implicates the significance of merging literature on residential segregation and immigrant enclaves to improve theoretical conceptualizations of immigrant neighborhoods [39].

We hypothesized that tract-level immigrant co-ethnic density would be associated with lower proportions of black immigrant preterm birth and that black racial concentration and neighborhood deprivation would be associated with higher proportions of black immigrant preterm birth in California neighborhoods. Instead, we found these neighborhood attributes were not significantly related to tract-level patterns of black immigrant preterm birth. The null association between immigrant co-ethnic density and preterm birth could stem from the relatively low levels of ethnic concentration in these neighborhoods. For instance, the maximum level of immigrant co-ethnic density was only 18.2% foreign-born black in this study, and most neighborhoods had less than 1% foreign-born black residents. Compared to studies of Mexican enclaves in California which can have co-ethnic densities of over 50% Mexican, it is possible that immigrant co-ethnic density levels were too low to detect any associations in our sample [40]. Future studies might consider a similar examination of black immigrant enclaves (using these three neighborhood attributes) in regions where black immigrants are much more concentrated in neighborhoods such as Miami, Florida [41].

The null association between immigrant co-ethnic density and preterm birth is similar to that found in Janevic et al.'s [16] study of ethnic enclaves and gestational diabetes risk among pregnant women in New York City, where there was no association between residence in an ethnic enclave and gestational diabetes risk among sub-Saharan African women. While our study focused on a different pregnancy outcome and our sample included births to both Caribbean-born and African-born women, 86% of births in our study were to sub-Saharan African mothers. Sub-Saharan African immigrants are also highly selected on critical socio-demographic characteristics, such as higher levels of educational attainment, that may make their birth outcomes generally less sensitive to tract-level social conditions [42]. Thus, even if tracts had higher concentrations of black immigrants than what we observed, immigrant co-ethnic density might remain a weak predictor of black immigrant birth outcomes in California.

Similar to other studies, we found null findings for neighborhood deprivation and black racial concentration. In Minnesota, Baker and Hellerstedt [26] found no association

between black racial concentration and preterm birth in black immigrant women. Janevic et al. [43] found no association between neighborhood deprivation and preterm birth among African and non-Hispanic black Caribbean mothers. Our research adds to the literature by exploring these associations in the state of California where the residential context is not significantly associated with black immigrant preterm birth.

This study has a few notable limitations. First, we use a tract-level measures of each neighborhood attribute, which may contribute to the null associations we report here. Smaller boundaries such as blocks, or block groups may offer a more appropriate for detecting contextual associations in this population. Nonetheless, census tracts are a widely-used measure of residential environments in public health studies, and our use of the measure allows for comparability with existing studies. Our findings are also subject to extrapolation. Given that the black immigrant population in California is small, and neighborhoods have low levels immigrant co-ethnic density our models may estimate immigrant co-ethnic density proportions that are not present in the state of California [44]. Further, our ecological study design limits commentary to individual preterm birth risk among black immigrants.

Despite these limitations, this ecological study is the first to describe black immigrant neighborhoods with consideration of both race-related (e.g., black racial concentration) and immigrant characteristics in the state of California. Beyond the examination of black immigrant neighborhoods outside of historically segregated settlements, this study also offers an exploration of immigrant enclaves where immigrant co-ethnic density is much lower, and neighborhoods are less clustered compared to studies of larger immigrant populations. While immigrant co-ethnic density is protective among some immigrant groups and for certain health outcomes, black immigrant neighborhoods are unique compared to other immigrant neighborhoods. This study offers preliminary evidence that in some residential contexts, black immigrant birth outcomes are not associated with immigrant co-ethnic density, even after adjusting for overall black racial residential segregation and socioeconomic conditions.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Singh, G. K., & Stella, M. Y. (1996). Adverse pregnancy outcomes: Differences between US- and foreign-born women in

- major US racial and ethnic groups. *American Journal of Public Health*, 86(6), 837–843. <https://doi.org/10.2105/AJPH.86.6.837>.
2. Elo, I. T., Vang, Z., & Culhane, J. F. (2014). Variation in birth outcomes by mother's country of birth among non-Hispanic Black women in the United States. *Maternal and Child Health Journal*, 18(10), 2371–2381. <https://doi.org/10.1007/s10995-014-1477-0>.
 3. Stein, C. R., Savitz, D. A., Janevic, T., et al. (2009). Maternal ethnic ancestry and adverse perinatal outcomes in New York City. *American Journal of Obstetrics and Gynecology*, 201(6), 584. <https://doi.org/10.1016/j.ajog.2009.06.047>.
 4. Elo, I. T., & Culhane, J. F. (2010). Variations in health and health behaviors by nativity among pregnant black women in Philadelphia. *American Journal of Public Health*, 100(11), 2185–2192. <https://doi.org/10.2105/AJPH.2009.174755>.
 5. DeSisto, C. L., Hirai, A. H., Collins, J. W., & Rankin, K. M. (2018). Deconstructing a disparity: Explaining excess preterm birth among U.S.-born black women. *Annals of Epidemiology*, 28(4), 225–230. <https://doi.org/10.1016/j.annepidem.2018.01.012>.
 6. Alio, A. P., Richman, A. R., Clayton, H. B., Jeffers, D. F., Wathington, D. J., & Salihu, H. M. (2010). An ecological approach to understanding Black–White disparities in perinatal mortality. *Maternal and Child Health Journal*, 14(4), 557–566. <https://doi.org/10.1007/s10995-009-0495-9>.
 7. Portes, A., & Rumbaut, R. G. (2014). *Immigrant America: A portrait* (4th ed.). Oakland: University of California Press.
 8. Crowder, K. (1999). Residential segregation of West Indians in the New York/New Jersey metropolitan area: The roles of race and ethnicity. *International Migration Review*, 33(1), 79–113. <https://doi.org/10.2307/2547323>.
 9. Scopilliti, M., & Iceland, J. (2008). Residential patterns of black immigrants and native-born blacks in the United States. *Social Science Quarterly*, 89(3), 551–572. <https://doi.org/10.1111/j.1540-6237.2008.00547.x>.
 10. Pickett, K. E., & Wilkinson, R. G. (2008). People like us: Ethnic group density effects on health. *Ethnicity Health*, 13(4), 321–334. <https://doi.org/10.1080/13557850701882928>.
 11. Bécares, L., Shaw, R., Nazroo, J., et al. (2012). Ethnic density effects on physical morbidity, mortality, and health behaviors: A systematic review of the literature. *American Journal of Public Health*, 102(12), 1–34. <https://doi.org/10.2105/AJPH.2012.300832>.
 12. Becares, L., Nazroo, J., & Jackson, J. (2014). Ethnic density and depressive symptoms among African Americans: Threshold and differential effects across social and demographic subgroups. *American Journal of Public Health*, 104(12), 2334–2341. <https://doi.org/10.2105/AJPH.2014.302047>.
 13. Logan, J. R., Zhang, W., Alba, R. D., & Logan, J. R. (2002). Immigrant enclaves and ethnic communities in New York and Los Angeles. *American Sociological Review* 67(2), 299–322.
 14. Walton, E. (2012). Resurgent ethnicity among Asian Americans: Ethnic neighborhood context and health. *Journal of Health and Social Behavior*, 53(3), 378–394. <https://doi.org/10.1177/0022146512455426>.
 15. Mason, S. M., Kaufman, J. S., Emch, M. E., Hogan, V. K., & Savitz, D. A. (2010). Ethnic density and preterm birth in African-, Caribbean-, and US-born non-Hispanic black populations in New York City. *American Journal of Epidemiology*, 172(7), 800–808. <https://doi.org/10.1093/aje/kwq209>.
 16. Janevic, T., Borrell, L. N., Savitz, D. A., Echeverria, S. E., & Rundle, A. (2014). Ethnic enclaves and gestational diabetes among immigrant women in New York City. *Social Science & Medicine*, 120, 180–189. <https://doi.org/10.1016/j.socscimed.2014.09.026>.
 17. Bloch, J. R. (2011). Using geographical information systems to explore disparities in preterm birth rates among foreign-born and U.S.-born Black Mothers. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, 40(5), 544–554. <https://doi.org/10.1111/j.1552-6909.2011.01273.x>.
 18. Mason, S. M., Kaufman, J. S., Daniels, J. L., Emch, M. E., Hogan, V. K., & Savitz, D. A. (2011). Black preterm birth risk in nonblack neighborhoods: Effects of Hispanic, Asian, and Non-Hispanic White ethnic densities. *Annals of Epidemiology*, 21(8), 631–638. <https://doi.org/10.1016/j.annepidem.2011.04.008>.
 19. Vang, Z. M., & Elo, I. T. (2013). Exploring the health consequences of majority-minority neighborhoods: Minority diversity and birthweight among native-born and foreign-born blacks. *Social Science & Medicine*, 97, 56–65. <https://doi.org/10.1016/j.socscimed.2013.07.013>.
 20. Williams, D. R., & Collins, C. (2001). Racial residential segregation: A fundamental cause of racial disparities in health. *Public Health Reports*, 116, 404–416. [https://doi.org/10.1016/S0033-3549\(04\)50068-7](https://doi.org/10.1016/S0033-3549(04)50068-7).
 21. Iceland, J., Weinberg, D. H., & Steinmetz, E. (2002). Racial and ethnic residential segregation in the United States 1980–2000 (Google eBook), p 151. <http://books.google.com/books?hl=en&lr=&id=LZZFqVt-zwC&pgis=1>.
 22. Read, J. G., & Emerson, M. O. (2005). Racial context, Black immigration and the U.S. Black/White health disparity. *Social Forces*, 84(1), 181–199. <https://doi.org/10.1353/sof.2005.0120>.
 23. Dominguez, T. P., Strong, E. F., Krieger, N., Gillman, M. W., & Rich-Edwards, J. W. (2009). Differences in the self-reported racism experiences of US-born and foreign-born Black pregnant women. *Social Science & Medicine*, 69(2), 258–265. <https://doi.org/10.1016/j.socscimed.2009.03.022>.
 24. Margerison-Zilko, C., Perez-Patron, M., & Cubbin, C. (2017). Residential segregation, political representation, and preterm birth among U.S.- and foreign-born Black women in the U.S. 2008–2010. *Health Place*, 46, 13–20. <https://doi.org/10.1016/j.healthplace.2017.04.005>.
 25. Grady, S., & McLafferty, S. (2007). Segregation, nativity, and health: Reproductive health inequalities for immigrant and native-Born Black Women in New York City. *Urban Geography*, 28(February 2015), 377–397. <https://doi.org/10.2747/0272-3638.28.4.377>.
 26. Baker, A. N., & Hellerstedt, W. L. (2006). Residential racial concentration and birth outcomes by nativity: Do neighbors matter? *Journal of the National Medical Association*, 98(801), 172–180.
 27. Waters, M. C. (1999). *Black identities: West Indian immigrant dreams and american realities* (pp. 243–284). New York: Russell Sage Foundation.
 28. Guest, A. M., Almgren, G., Hussey, J. O. N. M. (1998). The ecology of race and socioeconomic distress: Infant and working-age mortality in Chicago. *Demography* 35(1), 23–34.
 29. Fang, J., Madhavan, S., & Alderman, M. H. (1999). Low birthweight: Race and maternal nativity—impact of community income. *Pediatrics*, 103(1), 1–6.
 30. Alexander, G. R., Himes, J. H., Kaufman, R. B., Mor, J., & Kogan, M. (1996). A United States national reference for fetal growth. *Obstetrics and Gynecology*, 87(2), 163–168. [https://doi.org/10.1016/0029-7844\(95\)00386-X](https://doi.org/10.1016/0029-7844(95)00386-X).
 31. Wadhwa, P. D., Culhane, J. F., Rauh, V., et al. (2001). Stress, infection and preterm birth: A biobehavioural perspective. *Paediatric and Perinatal Epidemiology*, 15(2), 17–29. <https://doi.org/10.1046/j.1365-3016.2001.00005.x>.
 32. Hogue, C. J. R., & Bremner, J. D. (2005). Stress model for research into preterm delivery among black women. *American Journal of Obstetrics and Gynecology*, 192(5 Suppl), S47–S55. <https://doi.org/10.1016/j.ajog.2005.01.073>.
 33. Dole, N. (2003). Maternal stress and preterm birth. *American Journal of Epidemiology*, 157(1), 14–24. <https://doi.org/10.1093/aje/kwf176>.

34. Kane, J. B., Teitler, J. O., & Reichman, N. E. (2018). Ethnic enclaves and birth outcomes of immigrants from India in a diverse U.S. state. *Social Science & Medicine*, 209, 67–75. <https://doi.org/10.1016/j.socscimed.2018.05.035>.
35. White, K., & Borrell, L. N. (2011). Racial/ethnic residential segregation: Framing the context of health risk and health disparities. *Health Place*, 17(2), 438–448. <https://doi.org/10.1016/j.healthplace.2010.12.002>.
36. Mason, S. M., Messer, L. C., Laraia, B. A., & Mendola, P. (2009). Segregation and preterm birth: The effects of neighborhood racial composition in North Carolina. *Health Place*, 15(1), 1–9. <https://doi.org/10.1016/j.healthplace.2008.01.007>.
37. Messer, L. C., Oakes, J. M., & Mason, S. (2010). Effects of socioeconomic and racial residential segregation on preterm birth: A cautionary tale of structural confounding. *American Journal of Epidemiology*, 171(6), 664–673. <https://doi.org/10.1093/aje/kwp435>.
38. Messer, L. C., Laraia, B. A., Kaufman, J. S., et al. (2006). The development of a standardized neighborhood deprivation index. *Journal of Urban Health*, 83(6), 1041–1062. <https://doi.org/10.1007/s11524-006-9094-x>.
39. Viruell-Fuentes, E. A., Miranda, P. Y., & Abdulrahim, S. (2012). More than culture: Structural racism, intersectionality theory, and immigrant health. *Social Science & Medicine*, 75(12), 2099–2106. <https://doi.org/10.1016/j.socscimed.2011.12.037>.
40. Peak, C., & Weeks, J. R. (2002). Does community context influence reproductive outcomes of Mexican origin women in San Diego, California? *Journal of Immigrant Health*, 4(3), 125–136. <https://doi.org/10.1023/A:1015646800549>.
41. Kent, M. M. (2007). Immigration and America's Black Population. *Population Bulletin*, 62(4), 3–17.
42. Doodoo, F. N. A. (1997). Assimilation differences Among Africans in America. *Social Forces*, 76(2), 527–546. Accessed Aug 2, 2018, from <https://academic.oup.com/sf/article-abstract/76/2/527/2233699>.
43. Janevic, T., Stein, C. R., Savitz, D. A., Kaufman, J. S., Mason, S. M., & Herring, A. H. (2010). Neighborhood deprivation and adverse birth outcomes among diverse ethnic groups. *Annals of Epidemiology*, 20, 445–451. <https://doi.org/10.1016/j.annepidem.2010.02.010>.
44. Oakes, J. M. (2004). The (mis)estimation of neighborhood effects: Causal inference for a practicable social epidemiology. *Social Science & Medicine*, 58, 1929–1952. <https://doi.org/10.1016/j.socscimed.2003.08.004>.

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