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"Another Mexican Birthweight Paradox? The Role of Residential Enclaves and Neighborhood Poverty in the Birthweight of Mexican-Origin Infants"

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Abstract

Examining whether contextual factors influence the birth outcomes of Mexican-origin infants in the US may contribute to assessing rival explanations for the so-called Mexican health paradox. We examined whether birthweight among infants born to Mexican-origin women in the US was associated with Mexican residential enclaves and exposure to neighborhood poverty, and whether these associations were modified by nativity (i.e. mother's place of birth). We calculated metropolitan indices of neighborhood exposure to Mexican-origin population and poverty for the Mexican-origin population, and merged with individual-level, year 2000 Natality Data (n=490,332). We distinguished between neighborhood exposure to US-born Mexican-origin population (i.e. ethnic enclaves) and neighborhood exposure to foreign-born (i.e. Mexico-born) Mexican-origin population (i.e. immigrant enclaves). We used 2-level hierarchical-linear regression models adjusting for individual, metropolitan, and regional covariates and stratified by nativity. We found that living in metropolitan areas with high residential segregation of US-born Mexican-origin residents (i.e. high prevalence of ethnic enclaves) was associated with lower birthweight for infants of US-born Mexican-origin mothers before and after covariate adjustment. When simultaneously adjusting for exposure to ethnic and immigrant enclaves, the latter became positively associated with birthweight and the negative effect of the former increased, among US-born mothers. We found no contextual birthweight associations for mothers born in Mexico in adjusted models. Our findings highlight a differential effect of context by nativity, and the potential health effects of ethnic enclaves, which are possibly a marker of downward assimilation, among US-born Mexican-origin women.

Keywords

immigrant; immigration; ethnic enclaves; neighborhood residential segregation; Mexican; birthweight; poverty; USA

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Low birthweight and short gestation comprise the leading causes of neonatal death (Kington & Nickens, 2001; U.S. Department of Health & Human Services, 2000), and are related to poor developmental outcomes later in life (Behrman & Butler, 2006; Conley, Strully, & Bennett, 2003). Despite their relatively low socioeconomic status, Mexican-American women tend to have healthy birthweight babies (Hayes-Bautista, 2002; Jasso, Massey, Rosenzweig et al., 2004). This so-called health paradox seems to be due primarily to the positive birthweight outcomes of babies born to Mexican immigrant women (Acevedo-Garcia, Soobader, & Berkman, 2007b). Several explanations for this health paradox have been advanced, including selection of healthy women into the migration flow from Mexico to the United States. Others argue that Mexican immigrant women have better outcomes because strong social networks protect them during pregnancy (Acevedo-Garcia, Soobader, & Berkman, 2005; Acevedo-Garcia et al., 2007b; Jasso et al., 2004).

Examining whether contextual factors play a role in the birth outcomes of Mexican-origin infants may contribute to assessing rival explanations for the Mexican health paradox. In the absence of confounding, if selection were the primary mechanism, we would expect the protective effect of immigrant status to operate only at the individual level. On the other hand, if social or cultural factors also played a role, immigrant or ethnic enclaves may confer a protective effect above and beyond an individual's immigrant status. However, in health research the Mexican health paradox has been studied primarily at the individual level (Acevedo-Garcia & Bates, 2007a).

Immigration sociologists have long highlighted the role of ethnic enclaves in facilitating successful immigrant adaptation (Portes & Stepick, 1993; Wilson & Portes, 1980). Enclaves may offer cultural goods, social networks, and lower communication costs for non-English language speakers (Fernandez Kelly & Schauffler, 1996). Indeed, some evidence suggests that neighborhood ethnic density may benefit the health of some minority groups (Boydell, van Os, McKenzie et al., 2001; Eschbach, Mahnken, & Goodwin, 2005; Eschbach, Ostir, Patel et al., 2004; Finch, Lim, Perez et al., 2007; Patel, Eschbach, Rudkin et al., 2003).

Although the literature on ethnic enclaves is not specific to health or pregnancy outcomes, it suggests some pathways that could be operating. Ethnic enclaves may improve birth outcomes because social capital and social networks offer women instrumental or financial support (Fernandez Kelly et al., 1996; Menjivar, 2000; Portes & Rumbaut, 2006; Zhou & Bankston, 1996) during pregnancy; social networks and social control (family and community expectations) in the enclave reinforce norms regarding healthy behaviors and practices and sanction unhealthy ones (Zhou et al., 1996) that affect birth outcomes (e.g. smoking, diet); enclaves contain more informational resources (Portes, Kyle, & Eaton, 1992), or more community services catering to immigrant groups (language) (Zhou et al., 1996), e.g. related to reproductive health care; and enclaves may insulate individuals from potentially stressful discriminatory exposures to the majority population or other ethnic subgroups (Fernandez Kelly et al., 1996; Portes et al., 2006).

Although immigrant scholarship is primarily focused on the positive aspects of the enclave (Menjivar, 2000), enclaves may also exert negative effects on birth outcomes. Immigrants are likely to live in high poverty neighborhoods (Galster, Metzger, & Waite, 1999; Osypuk, Galea, McArdle et al., In Press), and aspects of deprived neighborhoods (such as fear of crime and poverty) are associated with low birthweight (Collins & Shay, 1994; Messer, Kaufman, Dole et al., 2006). The benefits of social networks and social support for immigrants may depend on the value of resources flowing through the network (Fernandez Kelly et al., 1996). In areas where poverty is high, networks may therefore lack sufficient resources to be protective, and/or to produce social capital (Menjivar, 2000; Roschelle, 1997; Wierzbicki, 2004). For example, an immigrant's limited ability to reciprocate in the context of scarce resources may cripple the network capacity or efficacy because impoverished immigrants have few resources themselves (Menjivar, 2000). These neighborhood factors may influence birth outcomes through several pathways, including health behaviors (e.g. smoking, nutrition, or prenatal care), psychosocial factors (e.g. depression, social support), and stress pathways (Behrman et al., 2006; Misra, O'Campo, & Strobino, 2001).

Theory and empirical evidence (Pearl, Braveman, & Abrams, 2001) suggest, however, that effects of neighborhood context on birthweight in this population may differ by nativity. As immigrants adapt to their new society, they are likely to move out of enclaves into areas that are less ethnically defined (Alba & Logan, 1991), a process referred to as spatial assimilation (Massey & Mullan, 1984). While immigrants may seek to live in enclaves as a function of both preference and necessity (Logan, 2002b), for non-immigrant ethnic minorities, residence in ethnically defined communities may reflect instead a process of blocked social and spatial mobility and the prospect of downward assimilation (Portes & Rumbaut, 2000). Downward assimilation denotes that as immigrants assimilate into the US society, they and/or their progeny experience eventual downward social mobility, e.g. integration into the most disadvantaged segment of society (Portes et al., 2006). Indeed, Latinos face substantial discrimination in housing markets (Turner, Ross, Galster et al., 2002), and Mexican Americans experience less social advancement with increasing generation compared to other immigrants (Portes et al., 2006). If US-born women of Mexican-origin reside in ethnic enclaves as a function of blocked social mobility, or if they are less able than immigrants to access salutary social networks within those enclaves (Fernandez Kelly et al., 1996), such neighborhoods may represent damaging social environments. Therefore, we hypothesize that living in immigrant enclaves will have a protective association with birthweight among Mexican immigrant women, but that ethnic enclaves will have a detrimental effect on birthweight among infants of US-born Mexican-origin women.

METHODS

Individual Health Data

We used the 2000 Detail Natality Dataset (U.S. DHHS, CDC, & NCHS, 2002) to obtain outcome data on birthweight, number of grams at birth. We excluded multiple births and those weighing less than 500 grams to eliminate influential outliers. We analyzed birthweight linearly, consistent with other multilevel birthweight studies (Buka, Brennan, Rich-Edwards et al., 2003; Collins & David, 1997; Morenoff, 2003; Pearl et al., 2001). We also excluded births in rural areas (since segregation is a metropolitan phenomenon), births in Metropolitan Statistical Areas (MSAs) with fewer than 100,000 population (masked); and births in MSAs with fewer than 5,000 Mexican-origin residents (Ellen, 2000; Shihadeh & Flynn, 1996).

We restricted our analyses to Hispanics/Latinos of Mexican origin, the largest Hispanic/Latino and immigrant subgroup in the US, and the group for which a birth outcome paradox has been documented. Our individual-level predictor of interest was maternal nativity. Women were classified as immigrants (foreign-born) if they were born in Mexico and as US-born if they were born in the US and self-identified as being of Mexican-origin ethnicity. We use the terms immigrant and foreign-born interchangeably in this manuscript.

Maternal age was modeled in five-year categories. We excluded births to women under 15 and over 45 consistent with other analyses (Rich-Edwards, Buka, Brennan et al., 2003). Other individual-level covariates included parity, infant sex, maternal education, marital status, and prenatal care (measured as trimester that care began) (per prior research (Geronimus, 1996; Morenoff, 2003)). These covariates may be confounders or mediators of neighborhood exposure associations. See Table 1 for additional covariate detail.

Metropolitan Area Data and Measures

To operationalize the prevalence of ethnic enclaves, immigrant enclaves, and neighborhood poverty, we used measures from the residential segregation literature, i.e. exposure indices, which we calculated for each Metropolitan Statistical Area (MSA), stratified by the nativity of Mexican-origin residents (US-born and immigrants). We operationalized these measures at the MSA level because MSAs approximate housing and labor markets and immigrant destination areas (Frey, 2006). In recent years, 98% of new permanent legal US immigrants settled in metropolitan areas, and over 50% of US immigrants settled in areas within only 10 metropolitan areas (Office of Immigration Statistics, 2006). These same patterns also hold for Mexican immigrants, and our analysis includes these 10 largest metropolitan regions housing new legal Mexican immigrants.

The exposure index of segregation is applied by demographers to denote the average neighborhood (i.e. census tract) environment of a certain group, including the degree of potential contact between two groups within a typical neighborhood (Acevedo-Garcia, Lochner, Osypuk et al., 2003; Galster & Mikelsons, 1995; Logan, 2002a; Massey & Fischer, 2000). The measures we employ in our analysis are measures of how residentially segregated Mexican-origin residents are across different metropolitan areas.

The residential segregation literature suggests that aspects of the metropolitan context (including the macroeconomic structure, racial segregation, and economic segregation) influence how residents come to reside in certain types of neighborhoods, as well as how that metropolitan context shapes the distribution of neighborhood quality (e.g. the concentration of poverty) available to residents in the first place (Jargowsky, 1997). So in addition to being a proxy for the actual neighborhood enclave environment within which the typical Mexican-origin mother resides, our exposure measures of residential segregation also stand in for other dimensions and processes of metropolitan social context that serve to concentrate racial/ethnic minorities in certain neighborhoods. Such processes or structures include racial discrimination prevalent in housing and labor markets (Turner et al., 2002), barriers to social mobility that racial minorities experience (Williams & Collins, 2001), or lack of infrastructure or networks, either formal or informal, to aid residents of color.

We distinguish the form of residential segregation by the nativity and ethnicity of one's neighbors, by calculating measures of potential contact with neighbors who are Mexican immigrants, and potential contact with neighbors who are US-born of Mexican origin, using the exposure measure of residential segregation. Using tract-level (i.e. neighborhood) Census 2000 data, we calculated exposure to three features of neighborhood environment, to create MSA-level measures. First we calculated neighborhood exposure to foreign-born (i.e. immigrant) residents of Mexican-origin – “exposure to Mexican immigrant enclaves”. Second, we calculated neighborhood exposure to US-born residents of Mexican-origin – “exposure to Mexican ethnic enclaves”. Third, we calculated neighborhood exposure to poverty – “exposure to neighborhood poverty”. See Equation 1:

$$ {}_{b}E_{c}=\sum_{i=1}^{n}\left[\left(\frac{b_i}{B}\right)(C_i)\right] $$

Adapted from Galster & Mikelsons (1995), where: ${}_{b}E_{c}$ denotes the exposure of group b to tract characteristic c, and where i = tract, b_i = tract population of a certain group (e.g. Mexican immigrants) in tract i, B = total MSA population of a certain group, C_i = a tract-level summary measure, e.g. tract % poverty. The theoretical range of ${}_{b}E_{c}$ is 0–1.

We calculated these three neighborhood exposures separately for the immigrant and the US-born Mexican-origin populations, resulting in 6 MSA-level neighborhood exposure measures, specifically: (1) neighborhood exposure of Mexican immigrants to (1a) other Mexican immigrants, (1b) US-born Mexican-origin residents, and (1c) residents in poverty; and (2) exposure of US-born Mexican-origin residents to (2a) Mexican immigrants, (2b) other US-born Mexican-origin residents, and (2c) residents in poverty. Our exposure measures are interpreted as the "neighborhood composition (e.g. tract % poverty, or tract % Mexican immigrants, or tract % US-Born Mexican-origin residents) in which the average immigrant (or US-born) Mexican-origin person resides in the MSA". For example, when we discuss high exposure to *immigrant enclaves*, we are talking about mothers living in an MSA where the average Mexican immigrant or US-born Mexican origin resident lives in a neighborhood with a high proportion of Mexican immigrants (1a or 2a). When we discuss mothers with a high exposure to *ethnic enclaves*, we are talking about mothers living in an MSA where the average Mexican immigrant or US-born Mexican-Origin person lives in a neighborhood with a high proportion of US-born Mexican-origin residents (1b or 2b). High exposure to neighborhood poverty is interpreted as living in an MSA where the average Mexican immigrant or US-born Mexican-Origin resident lives in a higher poverty neighborhood (1c or 2c). For univariate descriptive analyses only, we also produced exposure measures for the Mexican Origin population as a whole (combining immigrants with the US-born).

For regression, we modeled the exposure indices as quartiles with the reference group as the lowest quartile (low exposure). Comparison of the indices as linear measures indicated that indicator-coded quartiles fit the data better, although sensitivity models using linear specifications replicated the same patterns documented by quartiles (results not shown). Per prior research (Ellen, 2000; Osypuk & Acevedo-Garcia, 2008) we included the following MSA-level covariates centered at their grand mean: population size (log), and median household income (log), using Census 2000 data (Lewis Mumford Center, 2001; U.S. Census Bureau, 2009), as well as MSA altitude (Massachusetts Institute of Technology, 1987; Wilcox, 2001) (modeled linearly), and Census region (modeled as an indicator variable).

Analytic Methods

We first estimated univariates and bivariates with birthweight in SAS 9.1. Differences in mean birthweight were calculated with one-way ANOVA tests. We graphed the distribution of tract-level ethnic enclaves for Mexican origin residents for 6 MSAs using kernel density techniques in R software 2.3.1.

We then analyzed how birthweight was associated with the exposure indices described above (i.e. immigrant enclave, ethnic enclave, and neighborhood poverty) in two-level hierarchical multiple linear regression models of individuals within MSAs, using HLM 6.0 (Raudenbush, Bryk, & Congdon, 2005). Hierarchical linear modeling (HLM) methods are appropriate for modeling variables at different levels (e.g. individual and metropolitan), and for parceling the variance in the outcome (e.g. birthweight) within and between these levels, and producing standard errors that are adjusted for the multilevel data structure (Raudenbush & Bryk, 2002)

We present regression models stratified by nativity for two reasons. First, preliminary analysis carried out among the whole sample, testing interaction terms, indicated that nativity significantly modified the birthweight associations with neighborhood exposure measures (results not shown). Second, the main predictor variables of neighborhood exposures are different for each nativity group, since we calculated the exposure indices separately for US-born and immigrant women. We present crude regression model results (Models 1–3) with exposure indices only, then present models adjusted for all covariates (Models 4–9). In Models 1–6, we tested one exposure index at a time. In models 7–9, we included two exposure indices simultaneously, to examine how different exposure measures may predict birthweight after adjusting for each other. When we present the results, Panel 1 refers to results (e.g. Table 4 and Figure 2) for the US-born mothers, and Panel 2 refers to results for immigrant mothers.

We ran full maximum likelihood estimation models with robust standard errors. To test for linear trends in neighborhood exposure quartiles, we used the Wald test from modeling quartiles linearly. We graphed mean predicted birthweight by nativity and exposure to enclave quartiles using the coefficients from regression models. Lastly, this dataset conveys considerable power to investigate associations. Since we hypothesized neighborhood exposures to be distal contextual causes, we anticipated the effects would be small, thereby requiring a large dataset. We therefore focused on substantively meaningful associations in addition to statistically significant ones.

RESULTS

Our final sample, described in Table 1, included 490,332 infants of Mexican-origin mothers in 168 MSAs, of whom 64% were immigrants. The majority of the sample were higher parity women aged 20–29, who gave birth to male children, lived in the Western part of the US, achieved high school or less education, were married, and received prenatal care in the first trimester on average. Table 2 displays the MSA level univariates. The typical (median) Mexican-origin resident in these 168 MSAs lived in a neighborhood where over 40% of his/her neighbors were also of Mexican origin. Immigrants were more likely than the US-born to live in Mexican-origin neighborhoods; for example the median % tract Mexican origin was 43.7% for immigrants, and 37.5% for the US-born. The typical (median) Mexican immigrant lived in a neighborhood where 24.8% of her neighbors were also Mexican immigrants, and where 19.5% of her neighbors were US-born Mexican origin, while the typical US-born resident of Mexican origin lived in a neighborhood where 17.5% of her neighbors were Mexican immigrants, and 19.5% of her neighbors were also US-born Mexican origin. The average Mexican immigrant in these 168 MSAs lived in a neighborhood with 20.6% poverty, which is above one threshold for high poverty, defined as 20% (Galster, 2002). The median exposure to neighborhood poverty for the US-born of Mexican origin was slightly lower at 17.8%.

Table 3 lists metropolitan areas with the highest and lowest exposures to immigrant and ethnic enclaves, by resident nativity. For example, Salinas CA and Yuma AZ have the highest immigrant exposure to Mexican immigrant enclaves; McAllen TX and Laredo TX have the highest US-born exposure to Mexican ethnic enclaves. Areas like Flint MI, Honolulu HI, Pittsburgh PA and Nassau NY have the lowest exposures. The highest exposures to enclave areas are in the west and southwest.

Using kernel density graphs, Figure 1 displays how the distribution of tract-level % US-born Mexican (ethnic enclaves) for Mexican Origin residents varies substantially across 6 select MSAs; each MSA exposure measure is marked as a small vertical line below the x-axis. For example, in Pittsburgh and Boston, Mexican Origin residents do not live in enclaves; their distributions on the left are very spiked, narrow distributions, and the exposure measure approaches zero (exposures are <0.01). McAllen and Laredo have the highest exposure measures, and most Mexican origin residents live in ethnic enclaves (exposure for McAllen=.49, and Laredo=.48). The distributions for the high-exposure-to-ethnic-enclave MSAs are distinctly separate from moderate-exposure MSAs, (Brazoria and Yolo), which are in turn separate from the low exposure areas.

In multiple regression analysis, we found several birthweight associations with exposure to enclaves (Table 4). Among infants of US-born mothers of Mexican-origin, living in MSAs with the highest exposure to Mexican ethnic enclaves was associated with 52g lower birthweight (B= −52g, p=.002) compared to MSAs with the lowest exposure to ethnic enclaves (Panel 1, US-born, Model 1, 4^{th} vs. 1^{st} quartile), with a significant linear trend (p-trend=.002). This association reduced somewhat to −40g (p=.002) after adjusting for covariates (p-trend=.001; Panel 1, Model 4). These associations are illustrated in Figures 2a–2b. There was not a statistically significant trend between birthweight and exposure of US-born mothers to immigrant enclaves, especially after adjustment for covariates (Panel 1, Models 2 and 5). Infants of US-born Mexican-origin mothers living in MSAs with very high neighborhood exposure to neighborhood poverty exhibited 49g lower birthweight (B= −49, p=.006) compared to MSAs with low exposure to neighborhood poverty (Panel 1, Model 3; p-trend=.007), an association which reduced to −30g after covariate adjustment (Panel 1, Model 6; p-trend=.05).

Although there were some positive associations in unadjusted models between birthweight and exposure to both ethnic and immigrant enclaves among Mexican immigrant (i.e. foreign-born) mothers (Table 4, Panel 2, Models 1–2), they did not remain significant after covariate adjustment (Panel 2, Models 4,5,7,8). Similarly, birthweights of infants of Mexican immigrant women were not associated with exposure to high poverty neighborhoods, in either unadjusted or adjusted models (Models 3,6,9).

In our final group of models (Table 4, Models 7–9), we adjusted for two neighborhood exposure measures simultaneously, in addition to all covariates. As with results discussed above, we observed significant associations only for infants of US-born mothers of Mexican-origin, not among infants of Mexican immigrant mothers, so we discuss model results for the US-born here. Of all the neighborhood exposure measures, exposure to ethnic enclaves (i.e. neighborhoods with a high proportion of US-born residents of Mexican-origin) showed the most consistent associations with birthweight. Controlling for exposure to immigrant enclaves (i.e. neighborhoods with a high proportion of Mexican immigrants) strengthened the negative association between birthweight and exposure to ethnic enclaves among infants of US-born mothers (Panel 1, Model 7; Figure 2c). Infants of US-born mothers of Mexican-origin living in areas in the highest quartile of exposure to ethnic enclaves were 73g lighter than those in areas with the lowest exposure (B= −73g, p-trend<.001).

However, we also observed an opposite trend for the measure of exposure to immigrant enclaves in Model 7. Exposure to Mexican immigrant enclaves exhibited a positive association with birthweight among the US-born, after adjustment for (the detrimental) effect of exposure to ethnic enclaves. For example, infants of US-Born mothers of Mexican-origin living in areas with the highest exposure to immigrant enclaves gave birth to infants that were 44g heavier than their counterparts in areas with the lowest exposure to immigrant enclaves (B=44g, p trend=.01, Model 7, Figure 2g). Notably, the detrimental effect of exposure to ethnic enclaves outweighed the positive association of exposure to immigrant enclaves, at approximately twice the magnitude (e.g. compare Figures 2c and 2g, and compare the magnitude of the birthweight difference coefficient for the 4^{th} quartile of the exposure measures in Models 7 Panel 1 for ethnic enclaves and immigrant enclaves). Exposure to poverty remained non-significant (at p<.05) in the presence of either of the two enclave measures (US-born, Panel 1 Models 8–9).

DISCUSSION

This research study yielded three main new findings. (1) Across US metropolitan-areas, birthweight for infants of US-born Mexican-origin mothers was patterned by residential segregation levels including exposure to neighborhood ethnic enclaves, immigrant enclaves, and neighborhood poverty. (2) Higher exposure to ethnic enclaves was associated with lower birthweight among infants of US-Born mothers of Mexican origin; in other words, US-born Mexican origin women who lived in MSAs with *high* probability of potential residential contact with other US-born Mexican-origin neighbors gave birth to lower birthweight babies than US-born women in MSAs with *low* probability of potential residential contact with US-born-Mexican-origin neighbors. However, simultaneously, greater exposure to Mexican immigrant enclaves was associated with higher birthweight among US-born mothers. (3) Lastly, these associations between birthweight and neighborhood ethnic and immigrant enclaves were not observed for infants of Mexican immigrants in adjusted models.

Our interest in exploring the association between birthweight and contextual variables among the Mexican-origin population is two-fold. First, evidence that infants of foreign-born Mexican mothers have better birth outcomes than those of US-born Mexican-origin mothers, and comparable to those of US-born non-Hispanic white mothers, has led to speculation that this pattern reflects health selectivity among immigrants from Mexico to the US (Akresh & Frank, 2008; Rubalcava, Teruel, Thomas et al., 2008). Alternatively, the protective effect of foreign-born status may reflect a "Mexican cultural orientation". Some prior research has suggested that such cultural orientation is a group-level attribute, presumably associated with healthier behaviors during pregnancy and more social/family support. Unfortunately, in available datasets, including the one used here, it is not feasible to test the relative explanatory power of these competing hypotheses (Acevedo-Garcia et al., 2007a). However, in the absence of confounding, if health selectivity at the individual level were the only mechanism operating, we would not expect to see a contextual effect of ethnic enclaves above and beyond the individual-level effect of foreign-born status. We found significant birthweight associations with neighborhood exposures among infants of US-born mothers of Mexican origin but not among infants of Mexican immigrants. Therefore, this analysis suggests that the protective effect of immigrant status on birthweight may operate primarily at the individual level, which may be evidence of health selectivity among immigrants. However, our results are tentative since there may be residual confounding in our models (including from neighborhood-related selection and socioeconomic processes), and residual confounding may induce spurious contextual associations. However, the fact that there are differential effects for infants of US-born and foreign-born Mexican-origin mothers does suggest that contextual influences vary by nativity.

We did find contextual effects of exposure to ethnic enclaves for infants of US-born Mexican-origin women.. The negative birthweight associations we observed for exposure to ethnic enclaves among infants of US-born mothers of Mexican-origin may represent a marker for blocked social advancement and spatial mobility among second generation mothers, which sociologists have termed "downward assimilation" (Acevedo-Garcia et al., 2007a; Portes et al., 2000).

Our second interest in exploring contextual effects in relation to the Mexican health paradox was to assess whether there was evidence of a differential effect of contextual variables by nativity that may parallel evidence of nativity differences in the patterning of individual-level variables. Prior work has shown a differential maternal education gradient in birthweight by nativity. There is a clear inverse gradient between education and low birthweight for US-born Mexican-origin mothers while the maternal education gradient among foreign-born Mexican mothers is flat (Acevedo-Garcia et al., 2007b; Kimbro, Bzostek, Goldman et al., 2008). Similarly, for the contextual variables tested in these analyses, we found that the contextual associations were modified by nativity, i.e. sizeable and negative for US-born mothers compared to non-significant associations for Mexican immigrants (Figure 2). Other studies have documented null contextual effects of neighborhood income/poverty with low birthweight among immigrant mothers, while finding detrimental associations for the US-born (Collins et al., 1994). The weaker individual-level and contextual-level social gradients among the foreign-born suggest the need for more research to understand why immigrant health seems resilient to individual and contextual disadvantage. In prior work we have suggested that both health selection and cultural/social factors could explain attenuated gradients among immigrants (Acevedo-Garcia et al., 2005, 2007b).

Contrary to finding evidence that enclaves were either positive or negative for birthweight, we found evidence that enclaves influence infant health in both directions among the US-born. Exposure to US-born Mexican-origin residents has a negative effect on birthweight, which may be reflecting blocked social and spatial mobility (Portes et al., 2000), and/or capturing unmeasured harmful neighborhood conditions like crime, which are associated with worse birth outcomes (Messer et al., 2006; Pickett & Pearl, 2001). The positive association of exposure to Mexican immigrants is consistent with explanations that immigrant enclaves may be beneficial due to the presence of social networks or positive social norms (Fernandez Kelly et al., 1996; Portes et al., 2006; Zhou et al., 1996). However, it is important to note that the negative effect of exposure to US-Born Mexican-origin-mothers was about twice as large the positive effect of exposure to Mexican immigrants, indicating that on balance enclaves may have negative influences on birthweight for the US born.

We found birthweight associations with exposure to enclaves were more robust than the associations with exposure to poverty. This may suggest that social mechanisms operating in neighborhood enclaves may be more influential or relevant for birth outcomes than neighborhood deprivation (Patel et al., 2003; Zhou et al., 1996). Indeed, some researchers have found that structural associations between neighborhood poverty, neighborhood racial composition, and birthweight may be mediated by neighborhood social context (including crime, or neighborhood social relations/engagement) (Morenoff, 2003). Ethnic enclaves may also be capturing aspects of deprivation that are operating within the enclave among Mexican-origin populations that are missed by traditional poverty measures. For example, although Mexican Americans may live in a poor household or area, the effects of poverty may be buffered by embeddedness within a dense social network and system of social exchange that can provide needed resources to buffer families from income-related shocks (Velez-Ibanez, 1993). On the other hand, negative birthweight associations of ethnic enclaves may be implicating the saliency of racial discrimination/racism (Rich-Edwards, Krieger, Majzoub et al., 2001), of high crime areas (Messer et al., 2006) or of the neighborhood presence of gangs (Minnis, Moore, Doherty et al., 2008), which may be stressors for pregnant Mexican-origin women living there. However, we could not test such mechanisms with these data. Alternately, although the average level of neighborhood poverty experienced by Mexican origin populations in the US (20%) is high, we may have had limited variation in the MSA exposure to poverty variable. It also may be that controlling for metropolitan median income may have overcontrolled; however omitting median income from the analysis did not change results.

We found that although the sizes of the exposure to poverty and ethnic enclave associations were comparable in crude models, the coefficient for high exposure to poverty was considerably lower than high exposure to ethnic enclaves after adjustment. This suggests that individual-level risk factors seem to be mediating some of the poverty associations, but less so the ethnic enclave associations.

One strength of our study includes our conceptualization and measurement of two distinct dimensions of Mexican enclave neighborhoods: Mexican *immigrant enclaves* and Mexican *ethnic enclaves*. These two dimensions are often conflated in health studies, e.g. when researchers model neighborhood % Hispanic, or % Mexican-origin. Although these measures are often empirically correlated *within* metropolitan areas, the between-metropolitan-area differences (e.g. the off-diagonals of these measures by nativity) may inform how these two constructs are distinct and how they may operate in different ways to affect health. Areas with low exposure to US-born but high exposure to Mexican immigrants indicate relatively new, large-population settlement areas for 1st generation immigrants. Here, Mexican immigrants may be settling into areas that have been traditionally occupied by white immigrants, which have tended to have strong social ties and strong collective efficacy. For example, Chicago has high exposure to foreign born, but low exposure to US-born Mexicans. Chicago Mexican immigrant enclave neighborhoods have demonstrated high collective efficacy and lower crime, while Chicago Mexican ethnic enclaves neighborhoods have demonstrated the reverse (Sampson, 2008). The Mexican ethnic enclave may therefore translate to worse social environments due to higher exposure to neighborhood violence. Additionally, some areas with high %US-born neighborhoods but low % Mexican immigrant neighborhoods may be longstanding Mexican population settlements, some of which may have preceded the annexation of Mexican territory by the United States during the US-Mexico war of 1846–1848. In such areas historically, US-born residents of Mexican Origin have endured the effects of discrimination or historical exclusion (De Leon & Griswold del Castillo, 2006).

Greater uncertainty may be associated with distal causes like metropolitan exposure to enclaves that must operate through multiple interacting mediators to affect health, since distal causes rarely operate as a simple chain of linear events that can be easily summarized to individual-level factors. As such, distal causes often have smaller direct or weaker effects as estimated with traditional methods like regression, compared to proximal causes (Cook, 2005; Schwartz & Diez Roux, 2001). Notably, although the birthweight associations we found for exposure to ethnic enclaves (−40g to −73g) were one-half to one-third the size of the coefficient for smoking during pregnancy (−143g), our enclave exposure associations were larger than or comparable to the effect of several individual-level risk factors for birthweight including being single vs. married (−40g), being a first-born child (−78g), having grammar school vs. high school education (−45g), or being among the oldest (−78g) or youngest (−53g) maternal age groups (vs. age 25–29)(results not shown).

This analysis is subject to several threats to validity given its cross sectional design with observational data. Primarily, we might be observing these patterns due to migration-related residential selection or confounding. Selection between metropolitan areas is lower than that between neighborhoods, so in this respect our study may be more sound than neighborhood-based studies (Cutler & Glaeser, 1997). We controlled for confounding by country of birth by restricting our sample and segregation indices to Mexican-origin women. However if other immigrant characteristics or immigration processes are patterned by metropolitan area, then our estimates may be capturing other aspects of immigrant or population composition. For instance, although our model results were robust to addition and omission of the MSA level covariates, we did not adjust for a measure of MSA racial composition. Since demographers have documented that one limitation of the exposure measure is that it conflates residential segregation with population composition (Lieberson & Carter, 1982), we felt a priori that it was inappropriate to adjust for population composition.

Our study found enclave associations with birthweight after controlling for a range of individual-level factors, including prenatal care, marital status, age, education, and parity. In sensitivity models, we also controlled for maternal health behaviors including smoking and drinking alcohol during pregnancy. Although smoking and drinking alcohol did not influence our associations between exposure to enclaves and birthweight, we did not include them in final models since they are poorly measured on birth certificates. But with our data we could not model other behavioral influences like diet that might contribute to reproductive differences among Latinas (Guendelman & Abrams, 1995; Wolff & Wolff, 1995), nor could we model social processes (social networks) or other aspects of immigrant adaptation processes (e.g. language). We may not have adequately controlled for socioeconomic differences, since education was the only socioeconomic variable at the individual level.

We tested how contextual measures of immigrant enclaves might matter for health by contrasting differences by metropolitan area, using exposure indices that capture the average neighborhood environment in the metropolitan area. This is a common approach in the segregation literature (Galster et al., 1995; Logan, 2002a; Massey et al., 2000). Because we do not have neighborhood-level identifiers in the Natality data, we cannot establish that individual birthweight is patterned by neighborhood-level characteristics, only that individual birthweight is patterned by MSA-level residential segregation, or the probability of neighborhood contact within a region. Therefore, there may be large neighborhood variability within metro areas that is not captured with these indices. The extent to which the MSA-level exposure measure of segregation is a good proxy for the actual neighborhood-level environment of a resident is dependent on how narrow the distribution of neighborhood context is for a given group, within a metropolitan area. In some MSAs, the distribution is broad (Osypuk et al., In Press), suggesting that metropolitan exposure residential segregation measures should not be used *only* as a proxy for neighborhood context.

The MSA-level exposure measure is a summary measure of enclaves and as such it does not provide complete information on patterns of neighborhood residence with co-ethnics. However, MSA-level exposure measures are informative in a way that neighborhood-level measures are not, that is they provide information about patterns of concentration of the Mexican-origin population over entire regions. These patterns cannot be detected at the neighborhood level. These contextual/social processes occurring within regions may indicate different macroeconomic opportunities (labor force opportunities or segmentation), racial discrimination in housing or labor markets (Turner et al., 2002), historical exclusion of Mexican-origin populations (De Leon et al., 2006), or the ability to get ahead socioeconomically (social mobility); all of which may in turn influence health. Additionally, the concentration of populations in enclaves may indicate hostile community context against Mexican-origin residents or immigrants in general that may drive co-ethnics to avoid settling in white neighborhoods, in anticipation of hostility there (Yinger, 1995). For example, the anti-immigrant sentiment surrounding the bitter Proposition 187 campaign against undocumented immigrants in California was interpreted as an attack on all Mexicans in the US regardless of legal status (Lopez & Stanton-Salazar, 2001).

We modeled the metropolitan-level exposure to enclaves measure as a measure of residential segregation that is upstream of neighborhood environment, based on sociological research that suggests that neighborhood sorting processes (including racial residential and economic segregation), along with income generating processes, combine to cause the concentration of racial/ethnic minorities into high-poverty neighborhoods (Jargowsky, 1997). Since the public use birth records do not contain lower-level geographic identifiers, we were unable to test whether neighborhoods mediated the associations between metropolitan context and birthweight, given our theoretical model. However, the results from our analyses using metropolitan area measures suggest hypotheses for neighborhood-mediation studies. Longitudinal studies are necessary to inform how neighborhood and individual level socioeconomic status, and other important dimensions of neighborhood context, are associated with the health effects of living in neighborhood enclaves, including sorting out confounding from mediation.

Conclusion

To our knowledge, this constitutes the first study of the health effects of metropolitan-level exposure to ethnic and immigrant enclaves. Understanding contextual dimensions of the health patterns of the Mexican-origin population is important given the large size of this population, its projected growth over the coming generations, and its spatial concentration (Fry, 2008). Attention to the role of context may inform the Mexican health paradox, and elucidate etiology more broadly, for improving the health and health trajectories of Mexican-origin residents in the United States.

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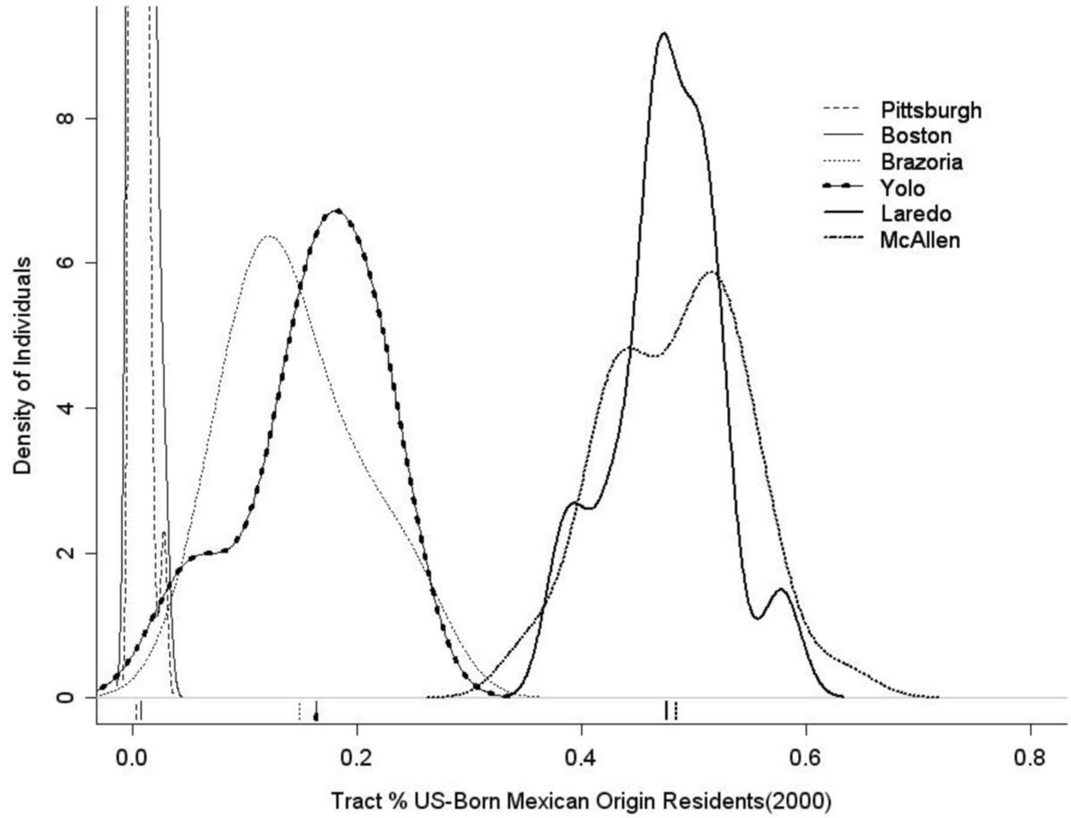

Figure 1.
Kernel Density of Mexican Origin Residents Living in Neighborhood % US Born Mexican for 6 MSAs

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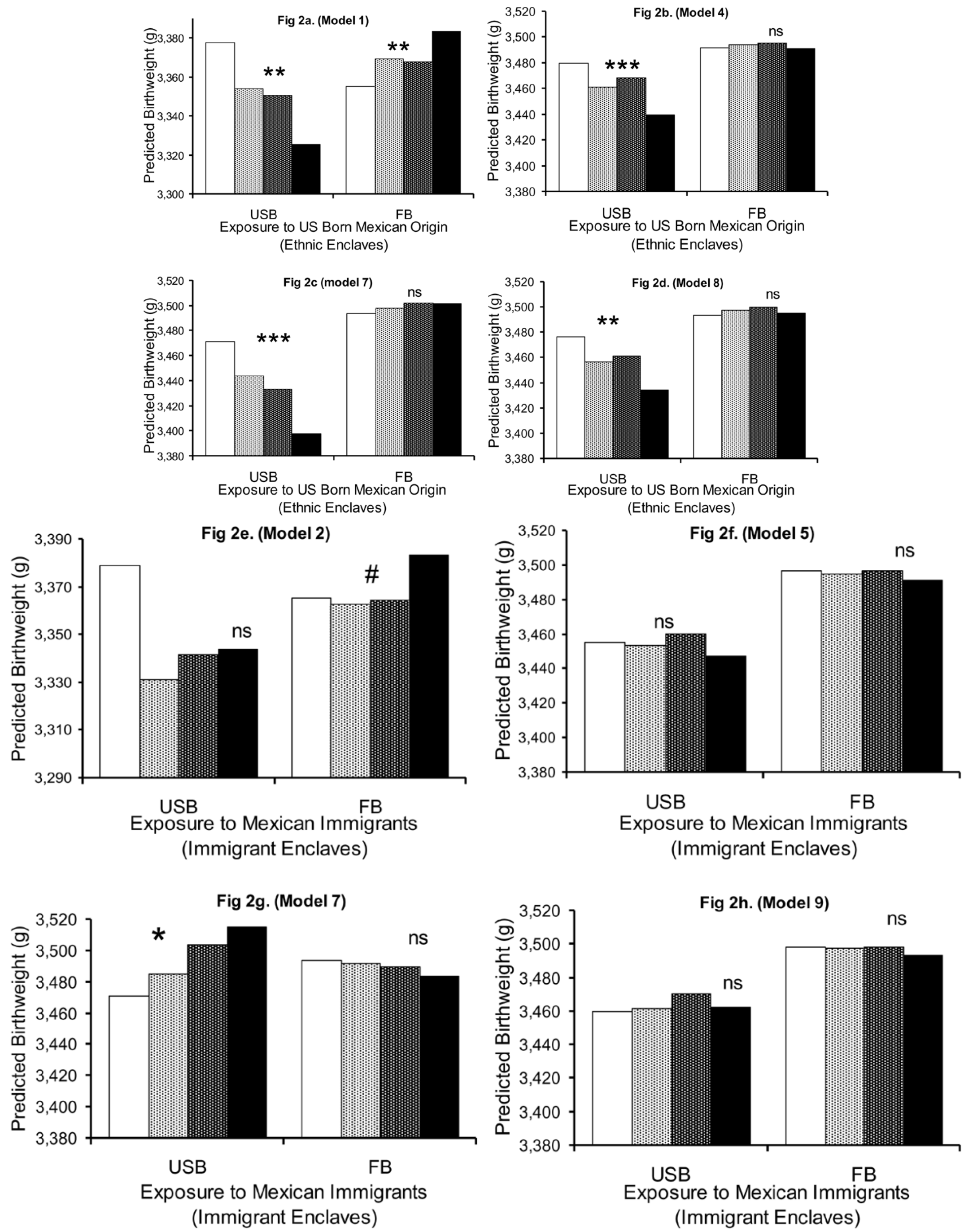

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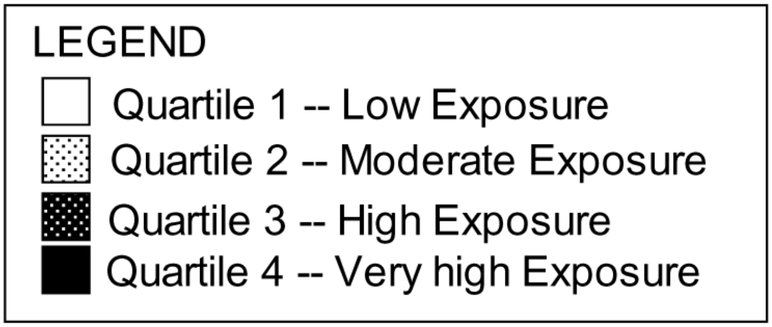

Figure 2.
(Panel). Predicted birthweight of infants born to Mexican-origin mothers by nativity and quartile of exposure measure.
FIGURE 2 NOTES: Trend test p-values denoted on figures: ***p<.001, **p<.01, *p<.05, #p<.10, ns p>.10. USB=US-Born, FB=foreign born (immigrant).

Table 1

Descriptive Statistics. Natality Data, Births to Mexican-Origin Mothers, Year 2000.

Variable	Category	N	% of sample	Mean Birthweight	ANOVA p-value
TOTAL		490,332	100.00%	3,364	--
Nativity	US born	177,635	36.23%	3,338	<.0001
	Foreign Born	312,697	63.77%	3,379	
Age	Age 15–19	80,448	16.41%	3,251	
	Age 20–24	153,578	31.32%	3,342	<.0001
	Age 25–29 (REF)	134,199	27.37%	3,405	
	Age 30–34	81,352	16.59%	3,428	
	Age 35–39	36,477	7.44%	3,411	
	Age 40–45	4,278	0.87%	3,376	
Parity	Not first born (REF)	312,240	63.68%	3,410	<.0001
	First born	178,092	36.32%	3,284	
Child Sex	Male (REF)	250,280	51.04%	3,410	<.0001
	Female	240,052	48.96%	3,316	
Region	Northeast	12,851	2.62%	3,330	<.0001
	Midwest	50,741	10.35%	3,368	
	South	155,888	31.79%	3,337	
	West (REF)	270,852	55.24%	3,381	
Education	Grammar School	119,003	24.27%	3,376	<.0001
	Some high school	143,868	29.34%	3,340	
	High School Graduate (REF)	138,017	28.15%	3,365	
	Some College	54,157	11.04%	3,389	
	Bachelors or more	25,443	5.19%	3,398	
	Missing education	9,844	2.01%	3,342	
Marital Status	Single (REF)	198,130	40.41%	3,321	<.0001
	Married	292,202	59.59%	3,393	
Prenatal Care	Trimester 1 (REF)	351,253	71.64%	3,376	<.0001
	Trimester 2	95,095	19.39%	3,352	
	Trimester 3	23,006	4.69%	3,333	
	No Prenatal Care	8,623	1.76%	3,189	

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Variable	Category	N	% of sample	Mean Birthweight	ANOVA p-value
	Missing	12,355	2.52%	3,293	

NOTES: REF indicates the reference group modeled for regression

Table 2

Metropolitan Variable Descriptives, Year 2000.

Variable	N	Mean	Quartile 1	Median	Quartile 3
Exposure to Mexican Immigrant Residents (Immigrant enclaves)					
Mexican Immigrant Exposure to tract % Mexican Immigrant residents	168	22.3%	17.7%	24.8%	28.5%
US-Born Mexican-Origin Exposure to tract % Mexican Immigrant residents	168	16.1%	9.7%	17.5%	23.4%
Exposure to US-Born Mexican Origin Residents (Ethnic enclaves)					
Mexican Immigrant Exposure to tract % US-Born Mexican origin residents	168	19.5%	16.0%	19.5%	23.3%
US-Born Mexican-Origin Exposure to tract % US-Born Mexican origin residents	168	20.9%	15.0%	19.5%	24.4%
Exposure to Poverty (Neighborhood Poverty)					
Mexican Immigrant Exposure to tract % poverty	168	21.6%	17.7%	20.6%	24.8%
US-Born Mexican-Origin Exposure to tract % poverty	168	18.3%	14.5%	17.8%	20.1%
Exposure to Mexican Origin Residents[a]					
Mexican Immigrant Exposure to tract % Mexican origin residents[a]	168	41.8%	34.1%	43.7%	51.7%
US-Born Mexican-Origin Exposure to tract % Mexican origin residents	168	36.9%	29.1%	37.5%	47.8%
Mexican Origin Exposure to tract % Mexican Origin residents[a]	168	39.2%	31.4%	40.3%	49.8%
Altitude (ft)	168	700	100	267	675
Population Size	168	3,616,145	753,197	2,813,833	4,177,646
Median Income ($)	168	$44,485	$41,053	$42,448	$48,364

[a] Mexican-origin refers to both immigrants and US-born of Mexican origin

Table 3

Metropolitan Areas with the Highest and Lowest Exposure to Mexican Immigrant Enclaves & Mexican Ethnic Enclaves.

Highest Exposure to Enclaves				Lowest Exposure to Enclaves			
Mexican Immigrants		US-Born Mexican Origin		Mexican Immigrants		US-Born Mexican Origin	
MSA	Exposure to Mexican Immigrant Enclaves	MSA	Exposure to Mexican Ethnic Enclaves	MSA	Exposure to Mexican Immigrant Enclaves	MSA	Exposure to Mexican Ethnic Enclaves
Salinas, CA	37.2%	McAllen, TX	48.8%	Flint, MI	0.6%	Pittsburgh, PA	0.6%
Yuma, AZ	33.8%	Laredo, TX	48.0%	Honolulu, HI	0.6%	Nassau--Suffolk, NY	0.7%
Orange County, CA	32.6%	Brownsville, TX	44.9%	Norfolk, VA--NC	0.6%	Cincinnati, OH--KY--IN	0.8%
Santa Cruz--Watsonville, CA	31.4%	El Paso, TX	42.9%	Pittsburgh, PA	0.6%	Boston, MA--NH	0.8%
McAllen, TX	31.2%	Las Cruces, NM	30.3%	Bremerton, WA	0.8%	Baltimore, MD	0.9%
El Paso, TX	29.2%	Visalia, CA	28.5%	Spokane, WA	0.9%	Newark, NJ	0.9%
Laredo, TX	29.0%	Fresno, CA	27.9%	Jacksonville, FL	1.0%	Jacksonville, FL	0.9%
Los Angeles--Long Beach, CA	28.5%	Tucson, AZ	27.6%	Saginaw, MI	1.1%	Louisville, KY--IN	1.0%

y Neighborhood Exposure Indices, Stratified by Nativity. Year 2000.

	US-Born Mothers																				
	Adjusted Models																				
	Model 3			Model 4			Model 5			Model 6			Model 7			Model 8			Model 9		
	B	(se)	p	B	(se)	p	B	(se)	p	B	(se)	p	B	(se)	p	B	(se)	p	B	(se)	p
**	3366.43	(13.17)	***	3480.19	(12.98)	***	3455.78	(12.78)	***	3463.38	(9.73)	***	3471.29	(14.28)	***	3476.78	(14.19)	***	3459.96	(14.11)	***
				−18.63	(13.66)								−27.21	(14.46)	#	−20.24	(13.57)				
				−11.78	(12.23)								−38.08	(17.38)	*	−15.26	(12.20)				
				−40.22	(12.72)	**							−73.37	(19.72)	***	−42.22	(13.51)	**			
*							−1.97	(14.73)					13.85	(13.61)					1.73	(13.90)	
							4.44	(12.42)					32.55	(16.54)	#				10.45	(12.53)	
							−8.21	(12.60)					43.88	(12.60)	*				2.34	(13.88)	
	−14.21	(15.94)								0.21	(8.81)					9.93	(9.51)		0.25	(9.30)	
	−9.06	(15.78)								−1.47	(9.66)					15.49	(10.70)		−1.30	(10.62)	
	−48.63	(17.16)	**							−29.94	(13.32)	*				1.28	(16.24)		−29.91	(16.00)	#
					***										***			**			
s									ns						*						ns

	US-Born Mothers																				
	Adjusted Models																				
	Model 3			Model 4			Model 5			Model 6			Model 7			Model 8			Model 9		
	B	(se)	p	B	(se)	p	B	(se)	p	B	(se)	p	B	(se)	p	B	(se)	p	B	(se)	p
			**									*						ns			#

	Foreign-Born (Immigrant) Mothers																				
	Adjusted Models																				
	Model 3			Model 4			Model 5			Model 6			Model 7			Model 8			Model 9		
	B	(se)	P	B	(se)	P	B	(se)	P	B	(se)	P	B	(se)	P	B	(se)	P	B	(se)	P
**	3374.81	(8.62)	***	3491.73	(9.33)	***	3496.89	(9.72)	***	3496.59	(8.40)	***	3494.12	(10.85)	***	3493.64	(10.21)	***	3498.46	(10.62)	***
				2.38	(8.32)								3.93	(8.05)		4.39	(7.81)				
				3.76	(8.44)								8.34	(10.48)		6.17	(9.17)				
				−0.25	(8.23)								7.45	(11.96)		1.97	(9.52)				
							−1.59	(9.65)					−2.57	(9.85)					−0.67	(9.60)	
							0.03	(9.30)					−4.48	(10.56)					0.00	(9.05)	
							−5.32	(9.37)					−10.54	(13.05)					−5.32	(10.05)	
	−10.13	(12.46)								−7.84	(8.00)					−7.62	(8.23)		−6.88	(8.10)	
	−4.49	(11.09)								−8.75	(7.74)					−10.03	(8.84)		−6.59	(8.48)	

Foreign-Born (Immigrant) Mothers

ls										Adjusted Models											
	Model 3			Model 4			Model 5			Model 6			Model 7			Model 8			Model 9		
P	**B**	**(se)**	**P**	**B**	**(se)**	**P**	**B**	**(se)**	**P**	**B**	**(se)**	**P**	**B**	**(se)**	**P**	**B**	**(se)**	**P**	**B**	**(se)**	**P**
	−2.75	(11.19)								−0.24	(9.70)					−0.81	(11.41)		2.88	(10.74)	
						ns									ns			ns			
*						—			ns						ns						ns
			ns									ns						ns			ns

as well as exposure measures, including demographic, socioeconomic, prenatal care, MSA level

2nd quartile, High corresponds to the 3rd quartile, and Very High (V.High) corresponds to the