How Does the Context of Reception Matter? The Role of Residential Enclaves in Maternal Smoking During Pregnancy Among Mexican-Origin Mothers

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Abstract This study investigated whether and how different patterns of group exposure within residential contexts (i.e., living in a Mexican immigrant enclave, a Mexican ethnic enclave, a pan-Hispanic enclave, or a non-Hispanic white neighborhood) are associated with smoking during pregnancy among Mexican-origin mothers. Using a hierarchical linear modeling approach, we found that Mexican-origin mothers' residential contexts are important for understanding their smoking during pregnancy. Residence in an ethnic enclave is associated with decreased odds of smoking during pregnancy, while residence in a non-Hispanic white neighborhood is associated with increased odds of smoking during pregnancy, above and beyond the mothers' individual characteristics. The magnitude of the associations between residence in an ethnic enclave and smoking during pregnancy is similar across the different types of ethnic enclaves examined. The important roles of inter- and intra-group exposures suggests that in order to help Mexican-origin women, policy makers should more carefully design place-based programs and

interventions that target geographic areas and the specific types of residential contexts in which women are at greater risk.

Keywords Immigrant health · Mexican · Maternal smoking during pregnancy · Ethnic enclaves

Introduction

Hispanics tend to have better health outcomes than non-Hispanic whites, despite their generally disadvantaged socioeconomic profile; such health advantages of Hispanics are referred to as the “epidemiological paradox” or the “Hispanic paradox” [1, 2]. In addition, Hispanic immigrants tend to have better health outcomes than both non-Hispanic whites and US-born Hispanics, which highlights the importance of considering nativity differences within the Hispanic paradox framework [3]. One area that has largely been overlooked in the literature on the paradox is maternal smoking during pregnancy, which is an important behavioral aspect of health that has significant implications for both the mother and her child [4]. Smoking during pregnancy puts women at increased risk for pregnancy complications [5] and is associated with various negative outcomes for infants, including preterm delivery [6, 7], low birth weight [5, 8–11], birth defects [12], and fetal and infant mortality [6, 13]. Furthermore, maternal smoking during pregnancy has lasting negative effects on children's cognitive development [14, 15], psychological health [16] and physical health [17, 18].

Despite these significant implications of maternal smoking during pregnancy for both the mother and her child, smoking is the leading preventable and modifiable health behavior during pregnancy [6] and the effects of

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smoking cessation are relatively substantial and immediate. For example, previous studies of smoking cessation patterns demonstrated that the odds of having a low-birth-weight infant become similar to those of nonsmokers if a mother quits smoking early in pregnancy [i.e., before the 16th week; 19]. Reflecting on the importance of maternal smoking during pregnancy, the Healthy People 2020 initiative identified reducing maternal smoking during pregnancy from 10.4 to 1.4 % by 2020 as one of its objectives [20].

Immigrant women are less likely to smoke than non-Hispanic white women and US-born women of the same ethnic origin [21–23]. Consistent with this pattern, foreign-born Mexican women have a lower rate of smoking during pregnancy than US-born Mexican women, who have a rate of smoking that well exceeds the Healthy People 2020 goal of 1.4 %. Previous studies have concluded that maternal smoking during pregnancy increases with acculturation [21, 24]. For foreign-born Mexican mothers, this is often attributed to a gradual loss of protective influences and greater exposure to unhealthy behaviors. The adoption of unhealthy behaviors may be intensified across generations, particularly in the context of downward assimilation into disadvantaged segments of American society [25, 26]. In fact, maternal smoking during pregnancy may be an important mechanism through which segmented assimilation influences low birth weight among Mexican-origin infants, and residential contexts may play a key role in this process [27].

Although modern epidemiological theories [28, 29] incorporate the roles of social and structural factors and provide a more complete foundation for understanding the complexity of changing immigrant health in the United States, previous studies of the influence of larger residential contexts on maternal smoking during pregnancy are scant. Furthermore, prior studies concentrated on one geographic location [30] or one racial/ethnic group [31]. No prior study has investigated the role of ethnic enclaves in smoking during pregnancy among Mexican-origin women. With growing heterogeneity in the ethnic composition of the United States and increasing numbers of Mexican immigrants, more nuanced research on “whether, how, for whom, (and) under what conditions” [32, 33] residential enclaves are protective is needed. This study responds to this call by investigating how different patterns of group exposure within residential contexts are associated with smoking during pregnancy among Mexican-origin mothers.

Data and Methods

Approval to conduct the research was obtained from the human subjects review board at The Pennsylvania State

University. The data used in this study come from two sources. The individual-level data were drawn from the National Center for Health Statistics (NCHS) 2008 restricted use detailed natality file [34]. This dataset is based on the total population of women who had a live birth in the United States during the 2008 calendar year, and includes detailed information on women’s prenatal care, birth experience, and birth outcomes as well as geographic identifiers. We restricted the individual-level data file based on several considerations. First, while the NCHS data file included information on all live births that *occurred* within the United States regardless of the mother’s residency status, we included only mothers who *resided* within the continental United States because this study focuses on the effects of residential contexts. In addition, California does not report whether women smoked during pregnancy on the birth certificate; thus, women who resided in California were excluded from the analysis consistent with previous studies [35, 36]. Second, this analysis was restricted to mothers aged 16 and older who identified themselves as “Hispanics-Mexicans,” including both the foreign born and the native born. The contextual-level data (at both the tract and county levels) come from the 2005–2009 American Community Survey 5-year estimates [37]. The two data sets were linked using geographic identification codes for county area of residence.

Individual-Level Variables

The dependent variable, smoking during pregnancy, is a dichotomous indicator of whether or not the mother smoked during her pregnancy (coded as 1 if she did and 0 if she did not). The foreign-born variable indicates whether or not the mother was born outside of the United States (coded as 1 if she was not born in the United States).

Individual-level maternal characteristics were selected drawing from previous studies on maternal smoking during pregnancy. First, sociodemographic characteristics were included in the models. *Maternal age* at the time of birth was measured as a continuous variable ranging from 16 to 50 years of age; both maternal age and age-squared variables were included in the models to test for the quadratic relationship between age and smoking during pregnancy. Also included was a dichotomous indicator of *marital status* that specified whether or not the mother was married at the time of the infant’s birth. A categorical measure of *maternal education* at the time of the infant’s birth was included as a measure of socioeconomic status. Four categories were represented with three dummy variables, using more than high school as the reference category: 0–8 years of schooling, some high school, and high school degree or GED.

Furthermore, various pregnancy-related characteristics were included in the models. *Maternal weight gain during pregnancy* was included as an indicator of the mother's overall health and nutrition during her pregnancy [38]. Maternal weight gain was measured as a continuous variable. Since excessive weight gain during pregnancy does not suggest good health and nutrition, preliminary models included weight gain squared to allow for nonlinearity in the relationship with smoking. The squared term was not significant and therefore dropped from the model.¹ A measure of *prenatal care utilization*, the adequacy of prenatal care utilization index (APCUI), was also included. The APCUI is a measure that takes into account the month that prenatal care began and the number of prenatal care visits and then adjusts for the gestational age of the infant at delivery. This accurate and comprehensive measure of prenatal care utilization [39, 40] was entered into our models as a set of dichotomous indicators, using inadequate care as the reference category: intermediate care, adequate care, and adequate plus care.

Contextual-Level Variables

Drawing from Massey and Denton's five dimensions of segregation (i.e., evenness, exposure, concentration, centralization, and clustering) [41], we focused on the dimension of exposure, which indicates the degree to which minority and majority group members potentially come into contact and interact by sharing common residential areas. Unlike the dimension of concentration that predominates in previous studies [42] and focuses on the presence of one racial or ethnic group in a residential area (i.e., "who lives in the neighborhoods"?), the dimension of exposure indicates the extent to which one racial or ethnic group may contact and interact with other groups. In this study, we utilized two basic measures of exposure: an isolation index and an interaction index. More specifically, we created four measures of residential contexts for all Mexican-origin mothers: Mexican foreign-born interaction (i.e., *Mexican immigrant enclave*); Mexican isolation (i.e., *Mexican ethnic enclave*); Hispanic interaction (i.e., *Hispanic pan-ethnic enclave*); and *non-Hispanic white interaction* (i.e., predominantly white neighborhood). More detailed information on these measures is available elsewhere [41, 43]. To make the interpretation more intuitive and to eliminate scale effects, we transformed our segregation measures to z-scores, or standard deviation units, for the multivariate analysis rather than arbitrarily assigning

cutoff points. To test whether these ethnic enclaves are proxies for regional differences, we created four regional control variables: Northeast, Midwest, South (reference) and West.

In addition, we controlled for socioeconomic status (SES) at the county level. Following previous studies [44, 45], county-level SES was measured with the following seven social conditions, using principal component analysis to capture the underlying construct with increased measurement precision (PCA). We confirmed the emergence of two factors (social affluence and concentrated disadvantage), which we then used to generate regression-weighted scales from the seven neighborhood characteristics. Specifically, social affluence included: log of per capita income (factor loading = 0.72), percentage of the population with at least a bachelor's degree (0.91), percentage of the population employed in professional, administrative, and managerial positions (0.87), percentage of families with annual income >\$75,000 (0.87). Concentrated disadvantage included: poverty rate (0.72), percentage of the population receiving public assistance (0.71), and percent of female-headed families with children (0.81). The PCA results indicate that almost 70 % of the variance was explained by these two factors (eigenvalues of 3.76 and 1.25, respectively).

Analyses

A series of multilevel logistic regression models was estimated using HLM 6.0 software [46]. For each model, we first assessed whether multilevel modeling was an appropriate analytic strategy by testing a null model with no explanatory variables. All null models had statistically significant variance of the intercept, which indicates that multilevel modeling was appropriate. The variances of the intercept indicated that a number of different contextual factors might explain a large proportion of the individual variance. For example, nearly 28.2 % of the variance in maternal smoking during pregnancy for Mexican-origin mothers was explained by contextual differences in the model including the measure of Mexican immigrant enclaves. After justifying the use of multilevel modeling, we investigated the relationship between individual- and county-level predictors and maternal smoking during pregnancy among Mexican-origin women using multilevel logistic regression models.

Results

Descriptive Statistics

Table 1 includes descriptive statistics for all measures included in the analysis by maternal nativity. There is

¹ Although the Institute of Medicine (IOM) guidelines for weight gain during pregnancy are based on pre-pregnancy Body Mass Index, information on maternal pre-pregnancy weight was not available. Therefore, we were unable to construct a categorical variable in line with the IOM guidelines.

Table 1 Descriptive statistics for study variables at both individual-level and contextual-level

	Foreign-born mexican mothers (n = 272,096)	US-born mexican mothers (n = 154,182)
Individual-level measures		
Smoking	0.50 %	4.43 %
Maternal age		
Age	26.93	24.46
Marital status		
Married	50.8 %	45.9 %
Maternal education		
0–8 years of schooling	30.8 %	3.2 %
Some high school	32.2 %	27.2 %
High school	24.8 %	34.0 %
More than high school	10.8 %	35.0 %
Weight gain during pregnancy		
Weight gain	26.17	29.83
Prenatal care utilization		
Inadequate care (reference)	31.8 %	26.4 %
Intermediate care	12.6 %	11.8 %
Adequate care	29.3 %	32.6 %
Adequate plus care	20.4 %	25.5 %
Parity		
First birth	28.2 %	40.5 %
County-level measures (for all mexican-origin mothers; n = 2,412)		
Segregation indexes		
Mexican immigrant enclaves	3.2 %	
Mexican ethnic enclaves	9.4 %	
Pan-Hispanic enclaves	10.5 %	
Non-Hispanic white neighborhood	76.3 %	
Socioeconomic status		
Affluence	0.00	
Concentrated disadvantage	0.00	

Differences between the means for foreign-born mothers and US-born mothers were statistically significant at $p < 0.001$ for all individual-level measures

significant variation in smoking during pregnancy by nativity among Mexican-origin mothers. Less than 1 % of foreign-born mothers reported smoking during pregnancy, compared to about 4.4 % of US-born mothers. These figures are considerably lower than the 9 % of all US mothers who reported smoking during pregnancy [35]. Nonetheless, the percent of US-born Mexican mothers who smoked during pregnancy well exceeds the Healthy People 2020 goal of 1.4 %.

The average age of foreign-born mothers was slightly under 27 compared to about 24 for native-born mothers, probably because the offspring of the former group were

less likely to be first births (28 %) than the offspring of the latter group (41 %). At the time of the birth, 51 % of foreign-born mothers were married compared to 46 % of U.S.-born mothers. There are large differences in the educational attainment of foreign-born and native-born Mexican mothers. For example, 30.8 % of foreign-born mothers had 0–8 years of education, compared to only 3.2 % of native-born mothers. In addition, the foreign-born mothers gained less weight during their pregnancy than the US-born mothers. They also had somewhat lower levels of prenatal care utilization. While 32 % of foreign-born Mexican mothers had inadequate prenatal care, 26 % of US-born Mexican mothers had inadequate prenatal care. Bivariate significance tests indicated that differences between the means for foreign-born and US-born mothers were significant ($p < 0.001$) for all variables.

The characteristics of the mothers' counties of residence varied considerably. Although we transformed our segregation measures to z-scores, or standard deviation units, for the multivariate analysis; we report the descriptive statistics for pre-transformed segregation measures. Only 3 % of the counties included in the models for Mexican-origin mothers were Mexican immigrant enclaves, or counties with high levels of exposure to Mexican immigrants. In contrast, about 9 % of the counties were Mexican ethnic enclaves, suggesting greater isolation of Mexican-origin mothers. Similarly, about 11 % of the counties were Hispanic enclaves. A much greater share of the counties (76 %) included in the models for Mexican-origin mothers had high levels of interaction between Mexican and non-Hispanic white residents. Socioeconomic measures were created using principle components analysis. Therefore these measures have a mean of 0 and a standard deviation of 1.

Multilevel Logistic Regression Results

The results in Table 2 demonstrate the associations between residential contexts and Mexican-origin mothers' smoking behavior during pregnancy. Each of the four models includes a different segregation index. Overall, the intercept-only null models (i.e., variance components intercepts) show that a substantial proportion of the variance in smoking behavior can be explained by differences between residential contexts. For example, as mentioned earlier, contextual differences explain nearly 28.2 % of the variance in maternal smoking during pregnancy for Mexican-origin mothers when residence in Mexican immigrant enclaves is considered. These variance component intercepts confirm that using the multilevel models is appropriate [43].

Individual-level results were consistent across models. Foreign-born Mexican mothers were significantly less

Table 2 Multilevel logistic regression models predicting the odds of maternal smoking during pregnancy for Mexican-origin mothers

	Model 1		Model 2		Model 3		Model 4	
	OR	p	OR	p	OR	p	OR	p
Individual-level measures								
Foreign-born mexican Mothers	0.079	***	0.072	***	0.073	***	0.075	***
Maternal age								
Age	1.389	***	1.395	***	1.393	***	1.392	***
Age squared	0.995	***	0.994	***	0.994	***	0.994	***
Marital status								
Married	0.460	***	0.453	***	0.453	***	0.455	***
Maternal education (ref: More than high school)								
0–8 years of schooling	1.658	***	1.622	***	1.619	***	1.623	***
Some high school	2.216	***	2.216	***	2.207	***	2.197	***
High school	1.667	***	1.676	***	1.671	***	1.665	***
Weight gain during pregnancy								
Weight gain	1.008	***	1.008	***	1.008	***	1.008	***
Prenatal care utilization (ref: Inadequate)								
Intermediate care	0.742	***	0.743	***	0.745	***	0.745	***
Adequate care	0.653	***	0.652	***	0.650	***	0.647	***
Adequate plus care	0.676	***	0.673	***	0.673	***	0.671	***
Parity								
First birth	0.813	***	0.810	***	0.811	***	0.813	***
County-level measures								
Segregation indices								
Mexican immigrant enclaves	0.670	***						
Mexican ethnic enclaves			0.650	***				
Hispanic enclaves					0.654	***		
Non-Hispanic white interaction							1.835	***
Controls								
Affluence	0.835	***	0.780	***	0.792	***	0.862	***
Concentrated disadvantage	0.951		1.060		1.054		1.187	***
West	1.853	***	1.536	***	1.627	***	1.340	***
Midwest	2.129	***	1.695	***	1.735	***	1.504	***
Northeast	2.308	***	1.808	***	2.189	***	1.959	***
Variance Components								
Intercept	0.282	***	0.216	***	0.236	***	0.254	***

*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$

likely to smoke during pregnancy than U.S.-born Mexican mothers. The odds of smoking during pregnancy were about 92 % lower [e.g., $1 - .079 = .921$] for foreign-born mothers than for US-born mothers. The association between maternal age and maternal smoking during pregnancy was significant; the odds of smoking were higher as the mother's age increased. However, the significant age-squared term indicates that the relationship was weaker at the oldest ages. Additionally, the odds of smoking during pregnancy were significantly lower for married compared to unmarried mothers and higher for mothers with relatively low educational attainment levels. Compared to

mothers with more than high school, the odds of smoking were approximately 66 % higher for mothers with 0–8 years of schooling, 122 % higher for mothers with some high school, and 67 % higher for mothers with a high school degree. Weight gain during pregnancy and prenatal care utilization were also significantly associated with Mexican-origin mothers' smoking during pregnancy. Similar to maternal education, a higher level of prenatal care utilization was associated with a reduced likelihood of smoking. Compared to mothers who received inadequate prenatal care, the odds of smoking during pregnancy for mothers who had intermediate, adequate and adequate plus

prenatal care were ~ 26 , 35 and 32 % lower, respectively. In addition, the odds of smoking during pregnancy were 19 % lower for pregnancies that resulted in a first birth than during later pregnancies.

The multivariate models show that in addition to explaining a substantial proportion of the individual-level variance in smoking, each of the four contextual measures of group exposure had a statistically significant influence on Mexican mothers' smoking during pregnancy. Specifically, the first model shows that the odds of maternal smoking were reduced by 33 % for each standard-deviation-unit increase in interaction with Mexican foreign-born residents (Mexican immigrant enclave). Thus, mothers residing in Mexican immigrant enclaves, defined by higher Mexican-foreign born segregation than average, had lower odds of smoking during pregnancy. Similarly, a unit increase in Mexican isolation (Mexican ethnic enclave) or pan-ethnic Hispanic interaction (Hispanic enclave) was associated with about a 35 % reduction in the odds of maternal smoking during pregnancy. In contrast, living in a county in which there was greater exposure to non-Hispanic white residents increased the odds of smoking during pregnancy for Mexican-origin women, after controlling for individual characteristics. The odds of smoking were nearly 1.84 times higher for each standard-deviation-unit increase in interaction with non-Hispanic whites. Associations between county-level socioeconomic status and maternal smoking during pregnancy were consistent across all four models, demonstrating that social affluence was associated with reduced odds of smoking during pregnancy for Mexican-origin mothers. Concentrated disadvantage was only significantly associated with the increased odds of smoking during pregnancy for Mexican-origin mothers in the model including exposure to non-Hispanic white residents.

Discussion

Our findings correspond to the ethnic enclave perspective in the existing segregation literature, which posits that concentrated social and structural resources within ethnic enclaves can be translated to positive health outcomes via multiple mechanisms [47]. In addition, our results suggest that different types of ethnic enclaves affect Mexican women's smoking during pregnancy in similar ways. Mexican-origin mothers living in Mexican immigrant enclaves were less likely to smoke while they were pregnant than otherwise similar Mexican-origin mothers living in contexts with lower levels of interaction with Mexican immigrants. A pattern comparable in direction and magnitude was found for living in a Mexican ethnic enclave or a pan-ethnic Hispanic enclave. Conversely, Mexican-origin

mothers who lived in residential contexts in which Mexicans had high levels of interaction with non-Hispanic whites were substantially more likely to smoke during pregnancy when compared to Mexican-origin mothers living in areas with lower levels of interaction between Mexicans and non-Hispanic whites. Future studies should investigate whether different types of ethnic enclaves have varying effects on other health outcomes for this population.

Lastly, our results for individual-level measures echo the findings reported in previous studies of smoking during pregnancy. Among Mexican-origin mothers, those who were younger [48], those who were married at the time of birth, and those with relatively high educational attainment were less likely to smoke while they were pregnant [35, 49, 50]. In addition, greater prenatal care utilization was associated with a reduced likelihood of smoking [51]. However, weight gain was positively associated with maternal smoking during pregnancy among Mexican-origin women, a pattern distinct from that found in a recent study of all mothers in the United States [35].

Despite these contributions, this study had several limitations. First, the exclusion of birth records from California may have created bias because a significant proportion of all Mexican-origin individuals reside in California. By excluding birth records from California, we may have underestimated the relationship between Mexican-origin mothers' residential contexts and maternal smoking during pregnancy. Second, the prevalence of maternal smoking during pregnancy among Mexican-origin women may be underestimated using the women's own reports [6]. If women perceive that there is a stigma associated with reporting smoking during pregnancy they may be reluctant to report it; this could lead to systematic underreporting of maternal smoking during pregnancy among Mexican-origin women residing in specific contexts of reception (e.g., Mexican immigrant enclaves). Third, several individual-level measures that may be associated with maternal smoking during pregnancy were not included due to data constraints (e.g., income, health insurance coverage, etc.). Although contextual-level socioeconomic status variables were included in the model in an attempt to account partially for the omission of a full set of measures of individual-level socioeconomic status, including more individual-level socioeconomic status variables is desirable when possible. Other individual-level measures of acculturation, such as English proficiency and bilingualism [52], should be considered in future research. In addition, future research should more carefully investigate how cohabitation is associated with maternal smoking during pregnancy among Mexican-origin mothers, given the high prevalence of cohabitation among this group [53]. Fourth, the data utilized in this study were cross-sectional, and a causal

relationship between maternal smoking during pregnancy and the explanatory variables could not be established. Future studies should utilize longitudinal data to better address the issue of causal inference for Mexican-origin women. Lastly, smaller geographic units like census tracts could have been used for the contextual-level measures, but the NCHS restricted use detailed natality data only include geographic information on the mother's state and county of residence. However, we argue that using the county as the unit of analysis has advantages, given that counties more accurately represent health care service markets than smaller units of geography [54], and that local policies often are implemented at the county level.

Conclusion

This study responded to the scholarly call for more nuanced research on “whether, how, for whom, (and) under what conditions” [32, 33] residential enclaves are protective for Mexican-origin mothers. Our focus on residential contexts extended the literature beyond its current emphasis on acculturation at the individual level, thereby expanding knowledge of immigrant health and the Hispanic paradox. In addition, this study moved beyond the typical analytic approach based on a single level of analysis by utilizing the multilevel logistic regression method.

The results of this study have important policy implications and lead to suggestions for future research. The findings demonstrate that the ethnic composition of the residential context influences Mexican-origin mothers' smoking during pregnancy. The distinct roles of different levels of contact and interaction between minority and majority group members in the residential environment suggest that programs and interventions should incorporate more carefully notions and issues of place. One clear implication is that geographic areas and residential contexts in which more women are at risk could be explicitly targeted for interventions. One possible approach is to provide culturally-sensitive health resources for mothers not residing in ethnic enclaves. Future research should investigate the specific mechanisms by which contexts of reception influence smoking during pregnancy among Mexican-origin mothers. For example, foreign-born Mexican mothers may be less susceptible than others to some potential negative influences of living in contexts characterized by low socioeconomic status due to an incomplete grasp of the system of stratification in the United States [55] or due to a different point of reference (e.g., comparing the residential context in the United States to Mexico). Furthermore, future research should investigate how the legal status of foreign-born Mexican mothers may mediate or moderate the relationship between their

residential contexts and their smoking behavior during pregnancy. Understanding such specific mechanisms is critical for the development of policies and programs that address prevention and intervention [56]. These findings strongly suggest that the effects of residential contexts are not monolithic, and therefore there is a need for further nuanced research.

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