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Smoking and Variation in the Hispanic Paradox: A Comparison of Low Birthweight Across 33 US States

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Abstract

The Hispanic Paradox in birth outcomes is well documented for the US as a whole, but little work has considered geographic variation underlying the national pattern. This inquiry is important given the rapid growth of the Hispanic population and its geographic dispersion. Using birth records data from 2014 through 2016, we document state variation in birthweight differentials between US-born white women and the three Hispanic populations with the largest numbers of births: US-born Mexican women, foreign-born Mexican women, and foreign-born Central and South American women. Our analyses reveal substantial geographic variation in Hispanic immigrant–white low-birthweight disparities. For example, Hispanic immigrants in Southeastern states and in some states from other regions have reduced risk of low birthweight relative to whites, consistent with a "Hispanic Paradox." A significant portion of Hispanic immigrants' birthweight advantage in these states is explained by lower rates of smoking relative to whites. However, Hispanic immigrants have higher rates of low birthweight in California and several other Western states. The different state patterns are largely driven by geographic variation in smoking among whites, rather than geographic differences in Hispanic immigrants' birthweights. In contrast, US-born Mexicans generally have similar or slightly higher odds of low birthweight than whites across the US. Overall, we show that the Hispanic Paradox in birthweight varies quite dramatically by state, driven by geographic variation in low birthweight among whites associated with white smoking disparities across states.

Keywords Birthweight · Decomposition · Hispanic Paradox · Smoking · States · Vital statistics

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Introduction: Hispanic Infant Health

Hispanic immigrant women have similar or lower risk of low birthweight compared to non-Hispanic white women (henceforth whites) (Acevedo-Garcia et al. 2007; Almeida et al. 2014; Buekens et al. 2000; Fuentes-Afflick et al. 1999; Leslie et al. 2003; Reichman et al. 2008). This finding is notable because Hispanic Americans have relatively low levels of socioeconomic status (Markides and Coreil 1986), similar to that of non-Hispanic blacks, a group with increased risk of low birthweight relative to whites (Lhila and Long 2012). This relatively favorable health outcome for the socioeconomically disadvantaged Hispanic population is an example of the "Hispanic Paradox."

Underlying Hispanic health similarities or advantages relative to whites may be muted in bivariate associations due to Hispanics' low socioeconomic status (Lariscy et al. 2015).[1] Past research suggests that socioeconomic status, specifically educational attainment, may be a fundamental cause of health disparities (Brunello et al. 2016; Hummer and Hernandez 2013; Link and Phelan 1995; Silles 2009). These socioeconomic differences are transmitted from parents to offspring; birthweight is one transmission pathway. Increased levels of parental educational attainment are generally associated with decreased rates of low birthweight (Frisbie 2005). In turn, low-birthweight infants have increased risk of infant mortality (Frisbie 2005), other adverse health outcomes (Reeves and Bernstein 2014), diminished school readiness and performance (Pinto-Martin et al. 2004; Reichman 2005), and reduced educational attainment (Behrman and Rosenzweig 2004). Low-birthweight infants also exact great monetary cost on families and taxpayers due to longer hospitalization stays in the postnatal period, increased spending on social services because of higher rates of cognitive disability, and lost parental income due to missing work to care for children in poor health (Petrou et al. 2001). Thus, Hispanics' relatively low risk of low birthweight may offset some of the harmful effects of socioeconomic disadvantage (Lariscy et al. 2015) and of discrimination (Araújo and Borrell 2006; Frank et al. 2010).

Not all studies have found a low-birthweight Hispanic Paradox. Research using older US data (Landale et al. 1999; Singh and Yu 1996) and recent findings from California (Sanchez-Vaznaugh et al. 2016) revealed higher risks of low birthweight among most Hispanic populations relative to whites. These studies also found heterogeneity in birthweight outcomes among Hispanic populations, with clear evidence of increased low-birthweight risk among US-born Mexican women and decreased risk among foreign-born Mexicans in comparison with whites. Sanchez-Vaznaugh et al.'s (2016) work is of particular interest; they observed increased risk of low birthweight among Hispanics (except foreign-born Mexicans) relative to whites in California. We argue that their study contrasts with estimates of infant health from other regions of the US (Almeida et al. 2014; Leslie et al. 2003). These discrepant findings suggest geographic variation in Hispanic–white birthweight differentials.

[1] Past research also finds evidence that the negative health effects of low educational attainment may be less pronounced for Hispanics, specifically Mexicans and Central and South Americans, than for whites (Acevedo-Garcia et al. 2007; Goldman et al. 2006; Turra and Goldman 2007).

Fenelon (2013b) and Lariscy et al. (2015) have shown that lower smoking among Hispanics relative to whites impacts the adult mortality Hispanic Paradox. We contend that smoking not only plays a role in the low-birthweight paradox, but it also may underlie geographic variation in Hispanic–white low-birthweight differentials. For example, high rates of smoking among whites in the Southeastern US (Fenelon 2013a) may have been responsible for a wider Hispanic–white birthweight gap in this region, relative to other US regions. Thus, our study tests smoking as a mediator for Hispanic–white birthweight differences and examines how these patterns vary geographically.

We first document geographic variation in Hispanic–white low-birthweight differentials using recent (2014–2016) vital statistics birth records. Second, we establish baseline birthweight differentials in each state, and then adjust for individual sociodemographic characteristics. Third, we examine the effects of prenatal smoking on low-birthweight differentials by ethnicity–nativity using a recently developed method of decomposition (Karlson et al. 2012). Lastly, we examine if state-level geographic variation in low birthweight is driven by state-level variation in birthweight among whites or Hispanics.

Factors Associated with State Variation in Ethnic Differentials in Low Birthweight

At the national-level, recent data from the National Center for Health Statistics (2015) showed that 7.2% of births to Hispanic women were low birthweight (< 2500 g), compared with 6.9% among births to whites (Martin et al. 2017: Table I-9). However, these national-level results mask potentially unique patterns across US states. For example, a recent study based on California data found that Hispanics have higher risk of low birthweight compared with whites (Sanchez-Vaznaugh et al. 2016). Another study (Leslie et al. 2003) observed similar rates of low birthweight between groups in North Carolina. Information from current vital records confirmed the existence of this variation; in California, 5.9% of white births and 6.5% of Hispanic births were low birthweight in 2015. These birthweight differentials were reversed in North Carolina: 7.5% of whites and 6.9% of Hispanics were low birthweight in 2015 (Martin et al. 2017).

The descriptive data from the National Center for Health Statistics Martin et al. 2017), while extremely valuable, does not stratify by maternal nativity, an important axis of differentiation for US birth outcomes. Analyses of nationally representative data have shown that immigrant women's babies exhibit lower rates of low birthweight compared with their US-born counterparts. Many attribute such a favorable pattern to positive immigrant selection processes (Reichman et al. 2008; Singh and Yu 1996). Moreover, geographic variance in immigrant selection may be related to geographic variation in Hispanic–white low-birthweight differentials. For example, recent mortality research also found geographic variation in Hispanic and white differentials (Brazil 2015; Fenelon 2016). Using county-level data, Brazil observed a diminished Hispanic mortality advantage (in comparison to whites) in established immigrant destinations as opposed to newer destinations. Fenelon's (2016) study, using individual-level data, similarly found decreased Hispanic mortality advantages in traditional destinations, relative to new and minor destinations. Furthermore, Riosmena and Massey (2012: 3) observed that Mexican immigrants to new destinations, Southeastern states, and Northeastern states may be disproportionately from "non-traditional origin regions" in Central and Southern Mexico, and specifically rural regions, potentially bringing with them specific characteristics of positive health selection. For example, these immigrants may have high levels of physical fitness that allow them to work in agriculture. On the other hand, individuals with poor health or disabilities may be less likely to migrate. In short, we test if Hispanic immigrant–white low-birthweight differentials vary across states of the US.

While the discussion thus far focuses on potential variation in health among Hispanics, state variation in Hispanic–white patterns of low birthweight could also be due to differences in the reference group, whites. Brazil (2015), for example, suggested that further examination of regional variation in white mortality in future research may reveal important insights into the Hispanic Paradox. Similarly, Fenelon's (2013a) research—which breaks up geographic units by state—on adult mortality shows a strong regional pattern in the effects of smoking on mortality, with high rates of mortality concentrating in the "Central South" (i.e., Kentucky, Tennessee, Alabama, and Mississippi). Furthermore, Fenelon's work demonstrated that regional divergence in US adult mortality over the last 50 years was largely based on differences in white mortality. Consequently, Hispanic–white differences in low birthweight across states may be driven by regional health divergences among the white reference group, rather than geographic variance in immigrant selection. Drawing on Fenelon's (2013a) work, we use states as the geographic unit of analysis to account for these regional health divergences among whites. Thus, we test if low-birthweight rates vary among Hispanics or whites (or both) by state.

The Role of Smoking: Resolving a Hispanic Paradox

Next, we examine how smoking patterns covary with state variation in Hispanic–white low-birthweight differences. Migration patterns may partially explain why Hispanics in North Carolina are less likely to smoke than whites. New arrivals may come from places of origin where smoking is much less common, and thus, assimilation into US smoking patterns has not occurred. Fenelon (2013b) argued that low smoking rates among Mexican immigrants may be rooted in Mexican culture or, more likely, rooted in economics and the traditionally less common availability of tobacco products in Mexico. As evidence, Fenelon (2013b) found that Mexican immigrants have vastly lower smoking rates relative to US-born Mexicans.

Past studies noted that low rates of smoking among Hispanic populations likely reduced their mortality rates relative to those of whites (Fenelon 2013b; Lariscy et al. 2015) and thus partly resolved the "Hispanic Paradox" of adult mortality (Markides and Coreil 1986; Markides and Eschbach 2011). But the effects of smoking go well beyond adult mortality, often impacting infants' health and well-being. For example, prior research documented a robust connection of prenatal smoking with low birthweight, operating through preterm birth and/or diminished fetal growth (Reeves and Bernstein 2014). Moreover, regional variations in adult mortality were attributed to smoking patterns (Fenelon 2013a). For example, North Carolina and Tennessee adults had high rates of smoking (ranked the 33th and 44th in 2015, respectively, in percent of adults who are current non-smokers among the 50 states) (Centers for Disease Control and Prevention 2017b). In contrast, California and Arizona adults had low rates of cigarette smoking (ranking 2nd and 5th in terms of non-smokers in 2015, respectively). The influence of state-level policy and public health campaigns (Fichtenberg and Glantz 2002; Levy et al. 2004; Moskowitz et al. 2000; Siegel 2002) on smoking patterns further motivates our state-level analysis of ethnicity–nativity birthweight differentials.[2]

Variation in Infant Health and Smoking by Hispanic Ethnicity and Nativity

Prior research observed substantial heterogeneity in health among Hispanic populations. As briefly mentioned above, nativity (foreign-born versus US-born) is an important factor in differentiating Hispanic health outcomes (Singh and Yu 1996). Past research has also generally observed a healthy immigrant effect in infant health outcomes for most Hispanic ethnic groups in the US (Acevedo-Garcia et al. 2007; Landale et al. 1999; Reichman et al. 2008; Singh and Yu 1996). For example, a study from the National Research Council demonstrated reduced low birthweight among foreign-born women in comparison with US-born women for all Hispanic populations examined: Mexicans, Cubans, Central and South Americans, and Puerto Ricans (Landale et al. 1999).

Prenatal smoking may play an important role in these patterns. Although Hispanics, on average, have lower rates of prenatal smoking than whites (Landale et al. 1999; Reichman et al. 2008), prenatal smoking rates are even lower among foreign-born Hispanics than their US-born peers (Acevedo-Garcia et al. 2007; Landale et al. 1999). Consequently, prenatal smoking likely plays an important role in differences in low birthweight among whites, US-born Hispanics, and foreign-born Hispanics. Yet, it is unclear how ethnic-nativity smoking differentials vary by geographic context within the US.

Other Factors Influencing Ethnic Differentials in Low Birthweight

We account for other potential influences on the relationship between ethnicity–nativity and birthweight. The majority of these factors relate to Hispanics' disadvantaged sociodemographic profiles. Other factors relate to demographic differences in fertility patterns between whites and Hispanics.

In addition to disadvantage in educational attainment, Hispanics have higher rates of unmarried births than whites (Shaw and Pickett 2013). Childbearing outside of marriage is associated with increased risk of low birthweight, serving as another means of

[2] California and Arizona enacted rigorous policies against smoking in the 1990s (Siegel 2002). For example, smoke free workplaces in California have been shown to reduce smoking rates and the effects of secondhand smoke (Fichtenberg and Glantz 2002; Moskowitz et al. 2000). Media campaigns against smoking in both states have also had considerable success (Levy et al. 2004).

socioeconomic disadvantage (Frisbie 2005). Hispanics, and specifically immigrants, have less adequate use of prenatal care than whites (Heaman et al. 2013; Leslie et al. 2003). As inadequate prenatal care usage is predictive of increased risk of low birthweight (Krans and Davis 2012), this may place Hispanics at an increased risk of low birthweight (Sanchez-Vaznaugh et al. 2016).[3] Lack of adequate prenatal care may also lead to widened infant health disparities at older maternal ages (Powers 2016).

Fertility characteristics, including maternal age at birth, and parity also disadvantage Hispanics. Hispanics, specifically Mexican immigrants, have more low parity births at young ages than whites (Parrado 2011), which potentially lead to increased risk of low birthweight (Kenny et al. 2013; Kozuki et al. 2013; Shah et al. 2010).

Data and Measures

Our study used data from the National Center for Health Statistics (NCHS) natality files from 2014 through 2016 (Centers for Disease Control and Prevention 2015, 2016, 2017a, 2018). These data included a variety of information on maternal socioeconomic and fertility characteristics and infant health. Through a special request to the National Center for Health Statistics and an approved Data Use Agreement, the data files also included maternal state of residence and maternal country of origin. We used those two variables to specify maternal state of residence and to differentiate births to US-born and immigrant women, respectively.

The 2014–2016 natality files included about 12 million births. We excluded births to women who are not US-born white, US-born Mexican, foreign-born Mexican, or foreign-born Central or South American. Moreover, we excluded states—including Washington DC—with less than 5000 births from these three Hispanic groups. We also excluded states with structurally missing data, such as complete missingness on maternal smoking.[4] We then used listwise deletion to eliminate cases with missing data because the STATA procedure ("khb") for our decomposition method did not allow for multiply imputed data (Kohler et al. 2011). Fortunately, missing cases were few and varied only in minor ways across states.[5] After these exclusions, our analytic file includes 6,823,979 total cases from 33 states. We organized states by region (Pacific, Southeast, Midwest, Southwest/Mountain, Northeast) for presentation of findings. For clarity, we concentrated our analysis on a geographically diverse set of states (California, Arizona, Illinois, and North Carolina) with large numbers of Hispanic births, and discussed results from other states on a case-by-case basis. Meanwhile, we broadly discussed the overarching geographic patterns in ethnic-nativity differentials in low birthweight as outlined above in our research aims.

[3] We use the concept of "adequacy" of prenatal care based on Kotelchuck's work (1994).

[4] Most states excluded have structurally missing data, such as Georgia and New Jersey, were missing data on smoking.

[5] We observed minor variation in missingness by state. Missingness is most common in California (3.6%) and Massachusetts (3.0%), and least common in Nebraska (0.1%) and Iowa (0.1%). We found no clear ethnic pattern of missingness in California. US-born whites are most commonly missing information (5.5%); US-born Mexicans (1.6%), foreign-born Mexicans (2.8%), and Central and South Americans (4.5%) have lower rates of missingness.

Our analysis included a variable for maternal ethnicity–nativity with categories for US-born white and the three largest Hispanic populations of births: US-born Mexican, foreign-born Mexican, and foreign-born Central and South American. We excluded US-born Central and South American, Cuban, and other Hispanic births due to their relatively small numbers in many states. We further excluded Puerto Rican births because past research indicates that the "Hispanic Paradox" does not apply to this population (Markides and Eschbach 2011; Reichman and Kenney 1998). We also dropped foreign-born whites to produce a more homogenous reference group, and dropped blacks and births from other populations to mirror analyses from Sanchez-Vaznaugh et al. (2016) and Fenelon (2013b).

In addition to ethnicity, our analyses included controls for other variables as shown in Appendix Table 3: maternal educational attainment, marital status at birth, maternal age, utilization of prenatal care, plurality, and parity. Marital status at birth contrasted those married and unmarried. We used a version of the adequacy of prenatal care index to measure utilization of prenatal care (Kotelchuck 1994). Our categories for prenatal care visits adhered to Kotelchuck's index: adequate, intermediate, and inadequate.[6]

We examined prenatal smoking as a mediator for ethnic differences in low birthweight. We dichotomized this variable (into smokers and non-smokers) to be consistent with Sanchez-Vaznaugh et al. (2016) and relevant to past research on low birthweight (Acevedo-Garcia et al. 2007) and infant mortality (Hummer et al. 1999). Smokers reported that they used cigarettes at least once a day at any point during the prenatal period. Non-smokers reported that they never smoked cigarettes during the prenatal period. Further tests suggested that using more detailed information on smoking patterns does not influence our results. Our outcome variable, birthweight, had two categories, low (< 2500 g) and non-low birthweight. We used this low/non-low-birthweight dichotomy to be consistent with past literature on the Hispanic Paradox and birthweight (Acevedo-Garcia et al. 2007; Landale et al. 1999; Reichman et al. 2008; Sanchez-Vaznaugh et al. 2016; Singh and Yu 1996).

Methods

First, we used logit regression to examine the association between ethnicity and the risk of low birthweight, stratifying by state. We stratified by state to examine Hispanic–white variation at the state level, and to avoid constraining state-level characteristics. The first set of models displayed the bivariate associations between ethnicity and birthweight. The second set of models adjusted for sociodemographic characteristics: maternal education, marital status, maternal age at birth, plurality, birth order, and adequacy of prenatal care.

[6] We include missing information as inadequate to account for missing cases in accordance with Kotelchuck's original index (1994). We found that classifying missing in this manner did not substantially change the results from using listwise deletion or multiple imputation. Percentage of missing cases does not substantively vary by ethnicity. Cases missing information have similar risk of low birthweight to cases in the inadequate care category with complete information in prenatal care.

Second, we used the KHB decomposition (Breen et al. 2013; Karlson and Holm 2011; Karlson et al. 2012; Kohler et al. 2011) to formally test whether Hispanics' low rates of smoking help to explain Hispanic–white birthweight differences. Unlike ordinary least squares regression, non-linear models do not hold coefficient scaling parameters—which are dependent on the model's total variance—constant between nested models. Thus, the addition of new covariates may have unexpected effects on coefficients due to rescaling, making mediation tests problematic. The decomposition overcomes rescaling issues, allowing for mediation tests for non-linear models. The estimator calculates residuals from a linear regression of a mediator on the predictor, with j regressions for j number of mediators, allowing it to take the information from the mediator that is not bound up in the predictor. Unlike a model which includes a mediator, a model which features a residualized mediator has the same scaling parameter as a model without the mediator. In the case of logit regression, log odds ratios of the relationship between the predictor and the outcome are obtained from these two models: a model which includes the residualized mediator and a model without a mediator. The indirect effect is obtained by subtracting the log odds ratios from these two models. Thus, the decomposition tests if the inclusion of the mediator results in a significant change in the association between the predictor and the outcome. The KHB decomposition applies the delta method to calculate standard errors for indirect effects (Karlson e al. 2012; Sobel 1987). Direct effects are equivalent to standard logit regressions of the outcome on the predictor. In sum, the decomposition escapes the non-linear model rescaling issue because it allows two nested models to have equal fit to the data, with the same error distribution and coefficient scaling parameter. In our analysis, direct effects are unmediated effects of ethnicity on low birthweight. The indirect effect is the smoking-mediated effect of ethnicity on low birthweight. Coefficients from logit regression and the decomposition are displayed as log odds ratios for ease of comparison.

Lastly, we ran ethnicity–nativity stratified logit regression models to examine if observed state variation were driven by Hispanic or white geographic differences in infant health.

Results

Table 1 displays cross-tabulations of low birthweight, prenatal smoking, and maternal education (dichotomized) by maternal ethnicity–nativity. We display results for all 33 states, organized by region. Overall, low-birthweight rates were higher for US-born whites (7.0%) and Mexicans (7.2%) than among foreign-born Mexicans (6.3%) and Central and South Americans (6.8%) (see bottom row). We observed the lowest rates of low birthweight for US-born whites in Pacific states, such as California. Rates of low birthweight were considerably higher in the Midwest and Southeast. For example, 5.8% of US-born whites in California were low birthweight, while 7.5, 6.9, and 6.6% of US-born whites in North Carolina, Illinois, and Arizona, respectively, were low birthweight. We observed similar patterns among US-born Mexicans. Among foreign-born Mexicans, however, we found little state variation in low birthweight. For example, 6.0% of foreign-born Mexicans in California are low birthweight, while 6.5, 6.4, and 6.4% of

Table 1 Ethnicity–nativity differences in prenatal smoking, bachelor's degree completion, and low birthweight by state

	W-US	M-US	M-FB	CS-FB	W-US	M-US	M-FB	CS-FB	W-US	M-US	M-FB	CS-FB	Obs.
Pacific													
CA	5.8	6.3	6.0	6.6	4.6	1.1	0.2	0.2	47.3	13.0	6.9	16.0	900,922
OR	6.1	6.3	6.3	7.6	13.5	6.4	0.4	0.6	35.1	10.1	4.1	21.0	113,044
WA	6.0	6.3	5.7	7.5	10.7	4.7	0.7	0.8	36.9	11.9	5.2	20.0	185,923
Southeast													
AL	8.0	7.6	6.4	7.2	15.1	3.7	0.3	0.3	29.8	8.8	2.2	5.2	114,911
AR	7.6	7.8	6.7	5.4	19.8	6.6	0.5	0.4	24.9	6.5	3.6	8.5	84,647
FL	7.2	7.1	6.0	6.7	11.5	3.1	0.4	0.2	32.0	8.3	5.2	27.6	355,068
KY	8.4	7.2	5.9	6.2	23.0	13.2	0.8	0.4	26.2	11.6	4.2	10.5	141,089
LA	7.8	8.2	6.4	6.8	10.5	5.5	0.3	0.3	32.5	13.8	6.0	8.6	106,813
NC	7.5	7.5	6.5	6.4	13.5	4.6	0.3	0.5	39.0	9.0	3.1	11.2	232,829
SC	7.4	7.9	6.2	5.8	15.0	6.2	0.7	0.4	35.7	10.8	4.1	11.5	107,893
TN	7.9	7.8	5.9	7.1	20.1	8.9	0.7	0.6	31.1	10.7	4.9	9.9	174,042
Midwest													
IA	6.3	7.0	5.9	7.2	16.7	11.8	1.0	0.6	38.3	9.4	4.4	8.7	102,789
IL	6.9	7.1	6.4	6.7	10.5	2.5	0.4	0.3	49.6	14.6	5.5	23.7	314,098
IN	7.5	7.6	6.3	7.0	17.9	7.8	0.8	0.4	30.4	11.9	3.9	13.7	203,951
KS	6.5	6.8	5.5	6.8	13.7	7.3	0.9	0.5	39.7	9.1	5.2	11.8	96,302
MI	6.9	7.6	6.1	6.1	15.9	10.6	1.0	1.3	34.7	12.6	9.6	19.6	233,205
MN	5.9	6.7	5.8	5.0	11.1	9.0	0.7	0.7	48.9	10.5	6.0	14.2	154,476
MO	7.3	6.5	6.8	7.2	19.8	12.3	1.4	1.2	34.4	14.9	6.2	15.0	173,296
NE	6.4	6.7	6.3	6.9	13.6	9.2	1.0	0.3	45.0	10.3	4.9	7.8	66,665
OH	7.3	7.9	5.7	7.4	19.1	15.5	1.2	0.9	33.6	13.5	6.4	13.4	310,380
WI	6.4	6.7	5.2	6.4	14.2	10.6	1.0	2.1	40.9	12.1	5.2	26.5	157,126

Table 1 (continued)

	W-US	M-US	M-FB	CS-FB	W-US	M-US	M-FB	CS-FB	W-US	M-US	M-FB	CS-FB	Obs.
Southwest/Mountain													
AZ	6.6	7.2	6.4	6.5	9.5	4.1	0.8	0.4	35.8	9.2	9.0	20.3	198,956
CO	8.4	8.7	7.4	9.0	8.1	6.6	1.0	1.1	49.9	13.1	5.8	22.7	152,018
ID	6.4	7.3	7.3	4.9	12.1	7.2	0.5	1.2	29.9	7.7	4.9	24.1	60,586
NM	8.3	9.1	6.8	7.8	12.3	5.8	1.2	0.5	36.4	14.2	8.3	28.5	36,867
NV	7.6	7.4	6.4	8.5	8.5	1.8	0.3	0.4	29.5	6.6	4.7	10.2	73,039
OK	7.3	7.7	6.6	6.3	15.6	6.7	0.6	0.2	27.9	8.2	6.7	13.0	113,566
TX	7.2	8.0	6.8	7.3	8.8	2.0	0.3	0.2	40.4	11.8	8.0	13.1	841,426
UT	6.7	8.0	7.3	7.5	4.1	4.4	0.4	0.2	37.3	9.7	6.3	21.8	130,606
Northeast													
MA	6.5	6.7	5.3	6.7	9.5	5.8	0.5	0.4	59.2	42.4	31.7	12.9	124,872
MD	6.6	6.5	6.3	7.0	11.8	4.3	0.8	0.4	52.4	26.5	6.8	8.4	113,678
NY	6.5	6.3	6.1	6.5	9.9	2.9	0.2	0.3	47.9	16.1	4.6	12.3	362,036
PA	7.0	6.9	5.9	6.6	16.5	10.7	1.1	0.8	41.4	15.7	6.9	20.3	286,860
	7.0	7.2	6.3	6.8	12.9	2.9	0.4	0.3	39.0	12.0	6.6	16.1	6,823,979

Source US Natality File 2014–2016

$N = 6,823,979$

foreign-born Mexicans in North Carolina, Illinois, and Arizona, respectively, are low birthweight. We also observed relatively low levels of geographic variation in low birthweight among foreign-born Central and South Americans.

Our results revealed similar patterns in geographic variation in prenatal smoking rates. Across all states, whites had the highest rate of prenatal smoking (12.9%), followed by US-born Mexicans (2.9%). Foreign-born Mexicans (0.4%) and Central and South Americans (0.3%) had extremely low smoking rates. We observed low levels of smoking in California and other Pacific states, but higher levels of smoking in states in other regions. For example, 4.6% of US-born whites in California smoked during the prenatal period, while 13.5, 10.5, and 9.5% of US-born whites in North Carolina, Illinois, and Arizona, respectively, smoked during the prenatal period. Smoking rates among whites were much higher in various states in the Southeast and Midwest, such as Kentucky (23.0%), Tennessee (20.1%), Missouri (19.8%), and Ohio (19.1%). We observed lower rates of smoking and similar, albeit less extreme, variation among US-born Mexicans. Among foreign-born Mexicans and Central and South Americans, however, we found low rates of smoking and little to no state variation in prenatal smoking rates. In sum, we find that Hispanic–white differences in prenatal smoking are widest in Southeast, and narrowest in some Western states, such as California (Table 2).

Our descriptive findings also revealed variations in bachelor's degree completion by state. US-born whites had the highest overall rates of bachelor's degree completion (39.0%), followed by Central and South Americans (16.1%), US-born Mexicans (12.0%), and then foreign-born Mexicans (6.6%). Again, variation—in absolute values—was widest among US-born whites. For example, values ranged 47.3 and 49.6% of US-born whites completing bachelor's degrees in California and Illinois, respectively, while 39.0 and 35.8% of US-born whites in North Carolina and Arizona completed bachelor's degrees. In contrast, the bachelor's degree completion rates varied less for US and foreign-born Mexicans. Bachelor's degree completion rates among Central and South Americans had somewhat wider variance.

In short, our descriptive results revealed lower low birthweight and prenatal smoking rates among immigrant Hispanics than US-born whites and Mexicans. US-born whites had higher levels of educational attainment than the three Hispanic groups. We also observed large geographic variation in low birthweight, smoking, and educational attainment among whites. This variation was muted among US-born Mexicans, and negligible (for birthweight and smoking) among foreign-born Mexicans and Central and South Americans.

Next, we display ethnic-nativity differentials in the odds of low birthweight using logit regression. Figure 1 displays results from bivariate models, stratified by state. Point estimates, standard errors, and statistical significance are displayed in Table 4 in the appendix. All statistical differences discussed below are significant at the 0.01 alpha level. We generally observed similar odds of low birthweight among US-born whites and US-born Mexicans. In some states, however, US-born Mexicans had somewhat higher rates of low birthweight. For example, in California and Arizona, US-born Mexicans had slightly higher odds of low birthweight than US-born whites. There was no significant difference in low birthweight between US-born Mexicans and US-born whites in Illinois and North Carolina. Foreign-born Mexicans, however, had lower odds of low birthweight than US-born whites in most states. This difference was widest in Southeastern states and parts of the Midwest. For example, foreign-born Mexicans had 0.17, 0.32, and 0.09 lower log odds of low birthweight in North Carolina, Tennessee, and Illinois, respectively, than US-born whites. Foreign-born Mexicans' low-birthweight advantage was negligible in some Pacific and Southwest/Mountain states, such as California, Oregon, Arizona, Texas, and Utah. Similarly, foreign-born Central and South Americans had lower odds of low birthweight than whites in Southeastern states and some states from other regions, but higher odds of low birthweight in some Pacific states, such as California. These results demonstrated substantial state variation in Hispanic immigrant–US-born white low-birthweight differentials. These gaps in low birthweight were widest in the Southeast—and less prominent in the Midwest, Southwest/Mountain, and Northeast. On the other hand, US-born and immigrant Hispanics had higher odds of low birthweight in several Pacific states, including California.

Figure 2 displays results from logit regression models which adjust for sociodemographic and fertility characteristics. Point estimates, standard errors, and statistical significance are displayed in Table 5 in the appendix. All statistical differences discussed below are significant at the 0.01 alpha level. Again, US-born Mexicans generally had similar odds of low birthweight to US-born whites after the addition of control variables. There were several exceptions to this pattern. For example, US-born Mexicans had lower odds of low birthweight in North Carolina (−0.14 log odds) and Missouri (−0.24 log odds), and higher odds of low birthweight than US-born whites in California (0.14 log odds). In contrast, foreign-born Mexicans and Central and South Americans had lower odds of low birthweight than US-born whites in most states. Again, this pattern was strongest in the Southeast and some Midwestern states. For example, foreign-born Mexicans had 0.56 and 0.25 lower log odds of low birthweight in North Carolina and Illinois, respectively, relative to US-born whites, net of other covariates.[7] The widest contrasts were observed in Southeastern states in the Central South, with 0.59, 0.70, and 0.67 lower log odds of low birthweight for foreign-born Mexicans relative to US-born whites in Alabama, Kentucky, and Tennessee, respectively. Contrasts between foreign-born Mexicans and Central and South Americans with US-born whites, however, were less prominent in many states in the Pacific and Southwest/Mountain. In short, results from adjusted models demonstrated that sociodemographic characteristics masked foreign-born Mexican and Central and South Americans' favorable infant health characteristics, relative to US-born whites. Again, our results revealed substantial state variation, with the widest differentials in the Southeast and some states in other regions. In contrast, Hispanic immigrants had little to no infant health advantage relative to whites in Pacific and some Southwest/Mountain states.

We followed these logit regression models with decompositions of the effects of ethnicity–nativity on low birthweight in Fig. 3. Point estimates, standard errors, and statistical significance are displayed in Table 6 in the appendix. All statistical differences discussed below are significant at the 0.01 alpha level. These decompositions

[7] We observed a divergent pattern in California, in which controlling for sociodemographic differences leads to increased odds of low birthweight for Hispanic groups relative to whites. We found that this pattern is robust to different methods and years of data.

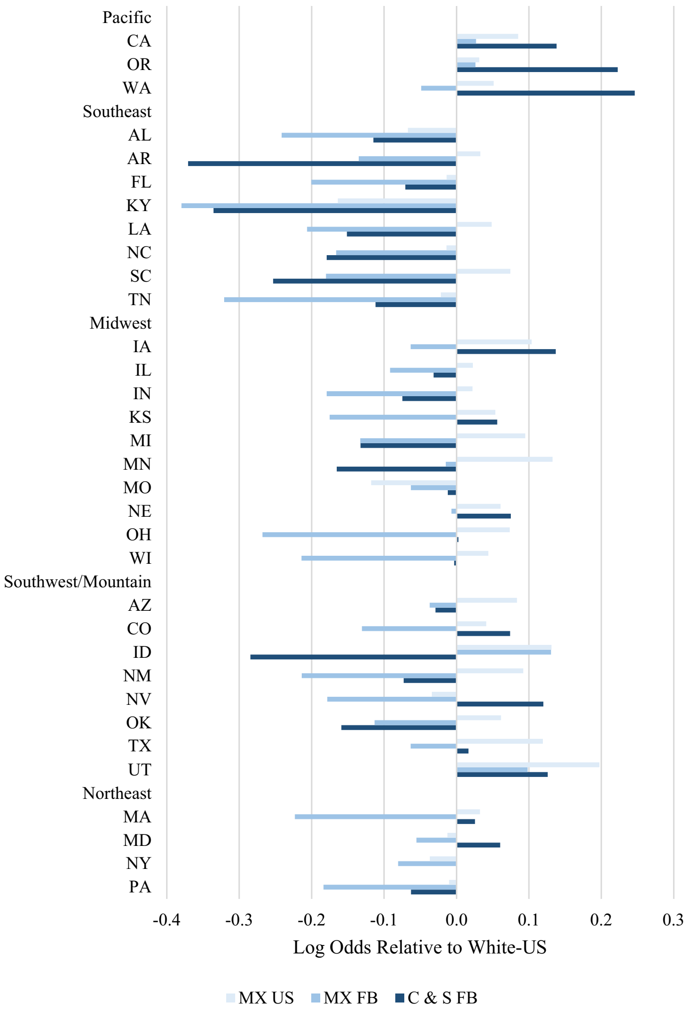

Fig. 1 Bivariate logit models of low birthweight on ethnicity–nativity, stratified by state (log odds/logits). *Source* US Natality File 2014–2016, $N = 6{,}823{,}979$

formally tested smoking as a mediator for ethnic differences in low birthweight. As previously mentioned, the direct effect is the residual association between ethnicity/nativity and birthweight that is not mediated by smoking; the indirect effect is the association between ethnicity and birthweight which is mediated by smoking. These associations are additive; for this reason, we display results for indirect and direct effects together (see Fig. 3). In some cases, the indirect and direct effects may cancel each other out (see Oregon for foreign-born Mexicans). In comparisons between US-born Mexicans and US-born whites, we found that US-born Mexicans' low rates of smoking are associated with reduced odds of low birthweight. In most cases, however, low rates of smoking only conferred modest low-birthweight advantages—in absolute magnitude—relative to US-born whites. However, in many states

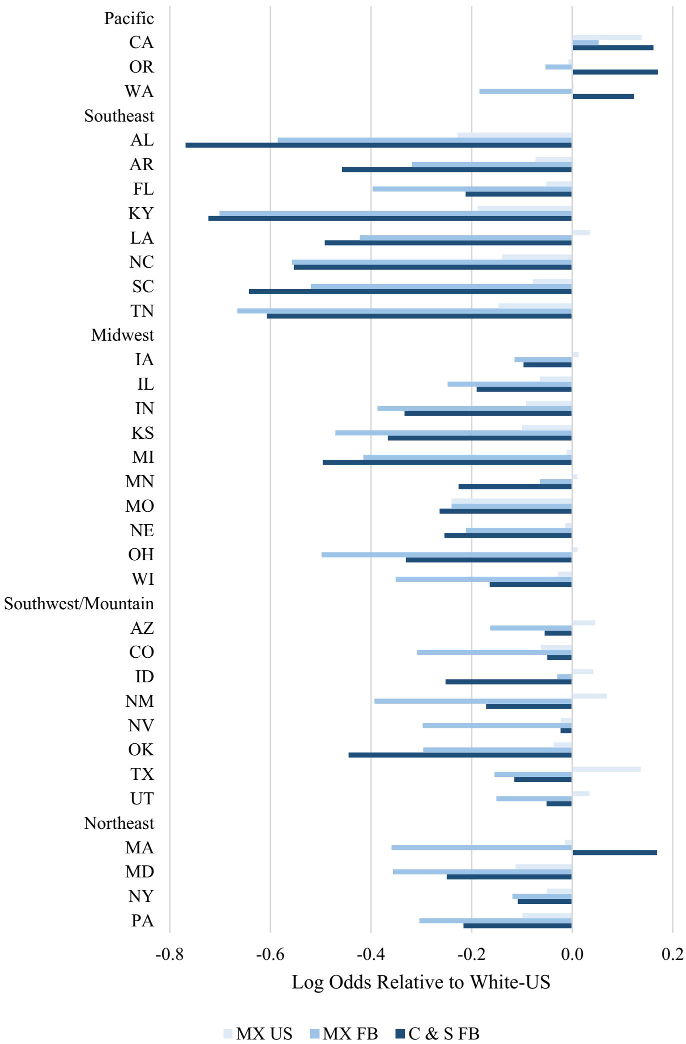

Fig. 2 Adjusted logit models of low birthweight on ethnicity–nativity, stratified by state (log odds/logits), $N=6{,}823{,}979$. *Source* US Natality File 2014–2016

smoking accounted for large percentages of the association (total effect) between US-born Mexican ethnicity and reduced odds of low birthweight. For example, smoking fully mediated US-born Mexicans' (modestly) decreased odds of low birthweight in North Carolina relative to US-born whites.

In contrast, smoking played a larger role—in absolute magnitude—for foreign-born Mexicans and Central and South Americans' odds of low birthweight in many Southeastern and Midwestern states. For example, smoking mediated -0.20 and -0.17 log odds of foreign-born Mexicans' reduced odds of low birthweight relative to US-born whites in North Carolina and Illinois, net of other covariates from the model. Thus, smoking accounted for 40 and 84% of foreign-born Mexicans' reduced odds of low birthweight in North Carolina and Illinois, respectively. Similarly, smoking accounted for foreign-born Central and South Americans' −0.18 and −0.13 log odds of low birthweight relative to US-born whites in North Carolina and Illinois, while holding other covariates constant. Smoking accounted for 37 and 93% of foreign-born Central and South Americans' reduced odds of low birthweight in North Carolina and Illinois, respectively. In fact, smoking played a similar role for immigrant Hispanic–US-born white low-birthweight differentials for most states in the Southeast, Midwest, and Northeast, with log odds ranging from −0.10 (Massachusetts) to −0.27 (Kentucky). Foreign-born Mexicans and Central and South Americans had a greater residual advantage in low birthweight in the Southeast than in the Midwest or Northeast. In contrast, ethnic-nativity smoking differentials played only a small role—in absolute magnitude—in some Pacific and Southwest/

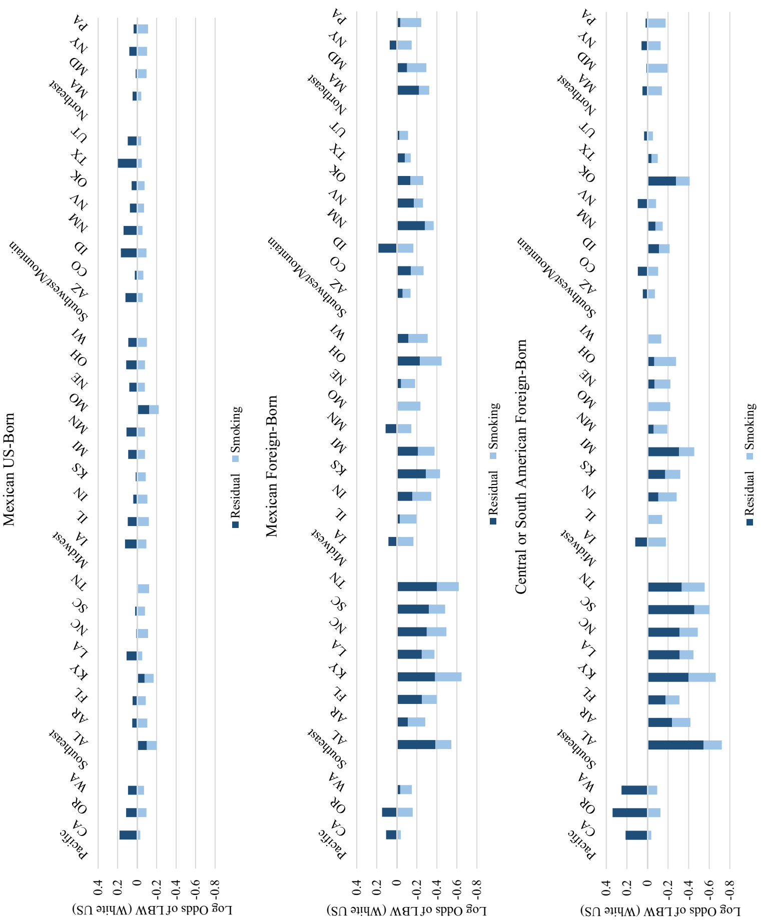

Fig. 3 Decompositions of smoking and residual effects of ethnicity–nativity, stratified by state (log odds/logits). *Notes* Karlson, Holm, and Breen decompositions control for maternal education, maternal age at birth, parity, plurality, adequacy of prenatal care, and birth year. Smoking is treated as a mediator, $N = 6{,}823{,}979$. *Source* US Natality File 2014–2016

Mountain states, such as California, Arizona, Texas, and Utah. In addition, the residual effect of ethnicity–nativity in these states was negligible or favored US-born whites relative to foreign-born Mexicans and Central and South Americans. In sum, results from decompositions revealed the meaningful role of state variation in smoking rates in Hispanic immigrant–white low-birthweight differentials. Immigrant Hispanics in the Midwest and Southeast benefitted from lower rates of smoking than US-born whites, whereas smoking played a relatively small role—in absolute magnitude—in several Western states with large Hispanic populations. The residual effect of ethnicity–nativity, however, was responsible for more state variation in low birthweight than smoking, driving the wide low-birthweight gaps in Southeastern states. Because of this large residual effect of ethnicity–nativity in the Southeast, smoking accounted for a larger percentage of Hispanic immigrants' reduced odds of low birthweight in Midwest states.

Is this Geographic Variation Driven by Whites or Hispanics?

Lastly, we tested if these observed patterns were driven by geographic variations in infant health among whites or Hispanic immigrants. We analyzed state variation in low birthweight, with models stratifying by ethnicity–nativity. For example, we examined state variation among US-born whites by pooling all 33 states and dropping all Hispanic births. We repeated this procedure with the three Hispanic populations. These logit regression models included all control variables previously used but did not use information on prenatal smoking (equivalent to Fig. 2). We observed substantial state variation in low birthweight among whites. Specifically, whites from most states, especially those from the Midwest and Southeast and parts of the Southwest/Mountain, had higher odds of low birthweight than whites from California. In contrast, we found limited evidence of state variation among Hispanic births. US-born Mexicans had increased odds of low birthweight in some states, relative to California. In contrast, we did not observe state variation in low birthweight for foreign-born Mexicans and Central and South Americans, which would have been consistent with geographic variation in patterns of immigrant selection. Most importantly, we found no pattern of healthier Hispanic immigrants in states which were considered new destinations.[8] In short, state variation in low birthweight among whites vastly exceeds state variation among Mexicans and Central and South Americans. This finding suggested that geographic variation in Hispanic–white low-birthweight differentials was—for the most part—driven by state variation in whites' rates of low birthweight. In short, we observed no consistent evidence of geographic variation in low birthweight among Hispanic immigrants. In contrast, variation in US-born whites' low birthweight drove the observed geographic variation pattern.

[8] We also ran bivariate logit models, stratified by ethnicity–nativity. These models observed similar patterns. In many instances, relationships observed were stronger in the adjusted models. This supplemental analysis demonstrates that geographic variation in the observed sociodemographic characteristics does not drive the patterns observed in this paper.

Table 2 Logit regression results from selected states of low birthweight on states and select covariates, stratified by ethnicity–nativity (log odds/logits)

	White US		MX US		MX FB		C & S FB	
	Logit	SE	Logit	SE	Logit	SE	Logit	SE
State (CA)								
Pacific								
OR	0.024	0.017	0.010	0.043	0.062	0.043	0.145	0.124
WA	−0.052	0.014*	−0.058	0.035	−0.105	0.036*	0.052	0.080
Southeast								
FL	0.146	0.011*	0.093	0.034*	−0.048	0.033	−0.109	0.029*
NC	0.328	0.012*	0.223	0.045*	0.065	0.031	−0.081	0.047
TN	0.238	0.013*	0.127	0.068	−0.104	0.048	−0.124	0.066
Midwest								
IL	0.187	0.012*	0.108	0.023*	0.045	0.023	−0.052	0.063
IN	0.262	0.012*	0.182	0.049*	0.010	0.047	−0.030	0.089
MI	0.188	0.012*	0.171	0.046*	−0.030	0.059	−0.251	0.111
Southwest/Mountain								
AZ	0.128	0.015*	0.108	0.019*	0.021	0.025	0.008	0.088
CO	0.427	0.014*	0.318	0.029*	0.203	0.033*	0.308	0.074*
TX	0.194	0.010*	0.248	0.012*	0.075	0.014*	0.013	0.031
Northeast								
MD	0.076	0.017*	−0.069	0.114	−0.050	0.075	−0.034	0.037
NY	0.057	0.011*	−0.008	0.056	0.046	0.034	−0.078	0.030
PA	0.136	0.011*	0.060	0.087	−0.045	0.069	−0.091	0.071

Source US Natality File 2014–2016

Notes States selected have the three largest populations of US-born Mexicans and foreign-born Mexicans and Central and South Americans within their region. Models control for maternal education, maternal age at birth, parity, plurality, adequacy of prenatal care, and birth year. See Table 5 in Appendix for results from all states

*$p < 0.01$

Robustness Tests

To assure that our findings are robust to alternative strategies, we performed several additional analyses. (1) We re-estimated associations with birth certificates from 2007 through 2010. (2) We ran equivalent logit regression models—without decomposition—using multiple imputation to recover data lost to listwise deletion of missing cases. Each analysis produced results consistent with those shown here.

Limitations and Measurement Error

The strengths of vital statistics data are many, including their sheer size, geographic coverage, completeness, and quality of birthweight measurement.

However, it is important to note that vital statistics data are cross-sectional and thus do not allow for clear causal inference. Nonetheless, our findings are unlikely to be due to reverse causality because the variables are temporarily ordered. For example, it is highly unlikely that infant birthweight would predict maternal ethnicity. In addition, maternal prenatal smoking has long been shown to influence infant birthweight and not vice versa.

Maternal smoking on birth certificates may be underreported. Recent research using North Carolina birth certificates finds that smoking measures are generally reliable, but results vary by maternal education (Vinikoor et al. 2010). Research using Washington State birth certificates demonstrates modest evidence of underreporting (Nielsen et al. 2014: 236); for example, Nielsen et al. find that 2% of reported non-smokers have biological markers consistent with prenatal smoking. Other research suggests that while smoking is underreported on birth certificates, patterns observed from birth certificates have been "confirmed" with other data sources (Ventura et al. 2003). Moreover, recent epidemiological studies have used US birth certificate data to examine the effects of smoking on birth outcomes (Donahue et al. 2010; Shaw et al. 2010). Some studies relying on older birth certificates, such as Northam and Knapp's (2006) literature review on birth certificate reliability, are more skeptical about the quality of smoking measures. The (seeming) improvement in the quality of smoking measures on birth certificates over time may be a product of deliberate efforts to improve this variable's measurement (Ventura 1999). In short, while underreporting of prenatal smoking is likely, birth certificate measures of prenatal smoking are reasonably reliable for population-level analyses. Consistency in findings between states in this study and with studies on regional variation in smoking and adult mortality (Fenelon 2013a) further demonstrates a degree of reliability in these data.

Discussion and Conclusion

Mexican and foreign-born Central and South American births were less likely to be low birthweight than were US-born white births in the Southeast and some states in the Midwest, Southwest/Mountain, and Northeast regions of the country. This health advantage existed despite immigrant Hispanics' socioeconomic disadvantage relative to non-Hispanic whites. The KHB methodology showed that Hispanic immigrant women's low rates of prenatal smoking (relative to non-Hispanic whites) mediated a large portion of their reduced odds of low birthweight in many states, a finding that paralleled Fenelon (2013b) and Lariscy et al.'s (2015) recent findings on adult mortality. Thus, Hispanics' low smoking rates benefit both infant and adult health in many state contexts. While smoking played an important role in explaining birthweight differentials in the Southeast and Midwest, it played a negligible role in some Western states with large Hispanic populations of births, such as California, Arizona, Texas, and Utah. In addition to this geographic variation in the role of smoking, we observed a powerful residual association between ethnicity and low birthweight in the Southeast. This finding indicates that other state attributes also impacted geographic variation in these Hispanic–white low-birthweight differentials. In contrast, US-born Mexicans had similar or slightly higher odds of low birthweight than US-born whites in most states. In sum, most birthweight patterns we observed were consistent with the Hispanic Paradox—i.e., similar or better health outcomes among Hispanics relative to whites—with the exception of California and some other Western states. Moreover, our analysis uncovered wider gaps in Hispanic immigrant–white low birthweight in the Southeast than in other regions.

Our analysis reveals, however, that this geographic variation in Hispanic immigrant–white birthweight differentials was not driven by state differences in immigrant selection. Rather, our results demonstrated consistent evidence of geographic variation among whites. For example, whites in the US Southeast had high rates of low birthweight, likely connected with high levels of prenatal smoking. Whites in Pacific and some Southwestern/Mountain states, however, had much lower odds of low birthweight, likely connected with lower levels of prenatal smoking. In contrast, foreign-born Mexicans and—and to a lesser extent—Central and South Americans had consistently low rates of prenatal smoking and low birthweight throughout the US. Simply put, the low-birthweight profile of foreign-born Mexicans throughout the US (6.3% low birthweight) was similar to that of US-born whites from states on the Pacific Coast, such as Oregon (6.1%). Meanwhile, foreign-born Central and South Americans had similar levels of low birthweight (6.8%) to US-born whites in Utah or Arizona (6.6–6.7%). Meanwhile, US-born whites in the Southeast had high rates of low birthweight, ranging from 7.2% (Florida) to 8.4% (Kentucky). For this reason, these immigrant populations had healthier birthweight profiles than whites in nationally representative estimates.

This study offers several important insights on Hispanic American health patterns. First, our analysis explained a large portion of the Hispanic Paradox in low birthweight. In most state contexts, a large portion of Hispanic immigrants' reduced risk of low birthweight is driven by low rates of prenatal smoking relative to US-born whites. Again, this pattern was likely driven by geographic variation in smoking among US-born whites, rather than among Hispanic immigrants. Second, the analysis revealed little geographic variation in the maternal health selection of Mexican and Central and South American immigrants. This finding contrasts with results from past research on adult mortality, which place more—or at least equal—emphasis on geographic variation among immigrant Hispanics than on the diversity of the white reference group (Brazil 2015; Fenelon 2016). Third, this study highlights the need for contextualization of white reference groups in state-specific analyses of Hispanic–white health differences. For example, a healthy white reference group likely drove patterns of favorable white health in California relative to Hispanics (Sanchez-Vaznaugh et al. 2016). Such findings from California cannot be extrapolated to other states with white populations with higher rates of low birthweight. Fourth, national-level analyses of Hispanic–white low birthweight differentials bely substantial geographic heterogeneity. Again, the national-level analysis is, in part, a story of reference groups. Hispanic immigrant groups with relatively homogenous birthweight patterns are compared with whites from heterogeneous health contexts. Our findings call into question the efficacy of comparing Hispanic immigrants, who tend to cluster in specific states, with whites from all states in the US. The application of state and county fixed effects may improve comparisons between Hispanic immigrants and whites in national-level analyses by restricting variation to individuals who live in the same geographic locations. Fifth, we found that Hispanic immigrants' sociodemographic disadvantage masks a considerably healthier infant health profile than that of US-born whites. Thus, policy efforts to increase socioeconomic opportunities for Hispanic immigrants may further improve infant health.

More broadly, Hispanic immigrants' relatively low odds of low birthweight may play a role in Hispanic–white health and socioeconomic differentials across the life course. First, the low-birthweight paradox contributes to Hispanic immigrants' low risk of infant mortality, at least relative to whites (Hummer et al. 2007). In turn, reduced infant mortality leads to increased overall life expectancy. Moreover, reduced risk of low birthweight may partly counterbalance Hispanic immigrants' low socioeconomic status in multiple realms. For instance, some research suggests that infant health boosts adult socioeconomic status (Behrman and Rosenzweig 2004; Conley and Bennett 2001; Haas 2006; Palloni 2006). Without their healthy infant health profile, Hispanic–white disparities in socioeconomic status would likely be wider.

Lastly, state variation in prenatal smoking and its impact on birthweight differentials highlights the import of smoking reduction campaigns. Extensive anti-smoking media campaigns funded by tobacco tax revenues have proven successful in certain states, such as California and Arizona (Levy et al. 2004); these interventions could serve as models for states with higher rates of prenatal smoking. More generally, smoking—whether during pregnancy or not—continues to extract an incredible health and mortality toll on the American public. This toll varies dramatically across states (Fenelon and Preston 2012). Aggressive policy and programmatic efforts could reduce this toll, particularly in states such as North Carolina, Tennessee, Missouri, and Ohio. Our results suggest that infants born to white and US-born Mexican American women in such states would particularly benefit from aggressive anti-smoking programs and policies.

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Appendix

See Tables 3, 4, 5, 6, 7, and 8.

Table 3 Descriptive statistics

	WH US	MX US	MX FB	C/S FB
Maternal education				
< HS	7.9	20.1	47.8	44.2
HS	21.3	34.4	31.6	23.0
Some college	31.8	33.5	13.9	16.8
BA	25.0	8.8	5.2	10.9
> BA	14.1	3.1	1.4	5.2
Adequacy of prenatal care				
Adequate	83.7	77.8	75.6	72.9
Intermediate	10.6	15.0	16.1	17.5
Inadequate	5.7	7.2	8.3	9.6
Maternal age				
< 21	7.4	19.4	8.2	7.6
21–24	16.5	27.2	15.9	14.0
25–29	30.4	27.1	28.1	26.4
30–34	30.2	17.6	26.9	28.7
35–39	13.0	7.4	16.2	18.3
40+	2.5	1.4	4.8	5.0
Plurality				
Single	96.3	97.6	97.8	97.5
Plural	3.7	2.4	2.2	2.5
Parity				
1	40.1	39.4	23.9	31.6
2–3	49.3	47.4	52.3	53.1
4+	10.6	13.2	23.8	15.4
Married				
Yes	69.6	44.2	53.8	49.76
No	30.4	55.9	46.2	50.24
Birth year				
2014	33.8	32.8	34.7	31.8
2015	33.4	33.5	33.7	34.0
2016	32.9	33.7	31.6	34.3

Source US Natality File 2014–2016

$N = 6{,}823{,}979$

Table 4 Bivariate logit regressions of low birthweight on ethnicity–nativity, stratified by state (log odds/logits)

	MX US		MX FB		C & S FB	
	Logit	SE	Logit	SE	Logit	SE
Pacific						
CA	0.085	0.011*	0.027	0.011	0.138	0.022*
OR	0.031	0.043	0.026	0.042	0.223	0.116
WA	0.051	0.034	−0.049	0.035	0.246	0.073*
Southeast						
AL	−0.067	0.089	−0.241	0.055*	−0.115	0.070
AR	0.033	0.069	−0.135	0.057*	−0.371	0.113*
FL	−0.014	0.033	−0.200	0.031*	−0.071	0.019*
KY	−0.164	0.097	−0.380	0.076*	−0.336	0.109*
LA	0.049	0.089	−0.206	0.078*	−0.151	0.057*
NC	−0.014	0.044	−0.166	0.029*	−0.179	0.040*
SC	0.074	0.083	−0.180	0.057*	−0.253	0.078*
TN	−0.022	0.064	−0.321	0.046*	−0.112	0.059
Midwest						
IA	0.104	0.066	−0.063	0.071	0.137	0.103
IL	0.023	0.021	−0.092	0.022*	−0.032	0.056
IN	0.022	0.046	−0.179	0.044*	−0.075	0.082
KS	0.054	0.049	−0.175	0.057*	0.056	0.103
MI	0.095	0.043	−0.133	0.056	−0.132	0.102
MN	0.133	0.064	−0.015	−0.015	−0.165	0.094
MO	−0.118	0.068	−0.063	0.069	−0.012	0.094
NE	0.061	0.064	−0.007	0.066	0.075	0.088
OH	0.074	0.053	−0.268	0.069*	0.003	0.068
WI	0.044	0.053	−0.214	0.054*	−0.003	0.132
Southwest/Mountain						
AZ	0.084	0.020*	−0.037	0.025	−0.029	0.083
CO	0.041	0.029	−0.130	0.032*	0.074	0.069
ID	0.131	0.059	0.131	0.066	−0.285	0.257
NM	0.092	0.046	−0.214	0.052*	−0.073	0.195
NV	−0.034	0.036	−0.178	0.039*	0.120	0.071
OK	0.061	0.046	−0.113	0.045	−0.159	0.094
TX	0.119	0.010*	−0.063	0.011*	0.017	0.021
UT	0.197	0.045*	0.098	0.045	0.126	0.077
Northeast						
MA	0.032	0.155	−0.223	0.155	0.026	0.044
MD	−0.013	0.107	−0.055	0.072	0.060	0.031
NY	−0.037	0.054	−0.081	0.032	0.000	0.021
PA	−0.010	0.083	−0.184	0.065*	−0.063	0.064

Source US Natality File 2014–2016

$N = 6{,}823{,}979$

Notes Models control for year of birth

$^{*}p < 0.01$

Table 5 Adjusted logit regressions of low birthweight on ethnicity–nativity, stratified by state (log odds/logits)

	MX US		MX FB		C & S FB	
	Logit	SE	Logit	SE	Logit	SE
Pacific						
CA	0.138	0.012*	0.053	0.014*	0.162	0.024*
OR	−0.008	0.047	−0.053	0.049	0.170	0.124
WA	0.003	0.038	−0.184	0.040*	0.123	0.079
Southeast						
AL	−0.228	0.096	−0.585	0.062*	−0.768	0.080*
AR	−0.073	0.075	−0.319	0.064*	−0.458	0.119*
FL	−0.051	0.035	−0.397	0.034*	−0.212	0.021*
KY	−0.188	0.102	−0.701	0.082*	−0.723	0.114*
LA	0.035	0.095	−0.422	0.084*	−0.492	0.064*
NC	−0.139	0.046*	−0.557	0.035*	−0.553	0.044*
SC	−0.078	0.091	−0.519	0.064*	−0.643	0.084*
TN	−0.147	0.069	−0.666	0.051*	−0.607	0.065*
Midwest						
IA	0.013	0.071	−0.115	0.079	−0.097	0.113
IL	−0.064	0.024	−0.247	0.026*	−0.190	0.061*
IN	−0.092	0.049	−0.387	0.048*	−0.333	0.088*
KS	−0.100	0.054	−0.471	0.065*	−0.367	0.111*
MI	−0.011	0.047	−0.415	0.061*	−0.496	0.109*
MN	0.011	−0.226	−0.064	0.070	−0.226	0.101
MO	−0.240	0.073*	−0.240	0.073*	−0.264	0.100*
NE	−0.014	0.070	−0.211	0.078*	−0.254	0.104
OH	0.010	0.056	−0.498	0.074*	−0.331	0.073*
WI	−0.028	0.057	−0.351	0.060*	−0.164	0.144
Southwest/Mountain						
AZ	0.045	0.023	−0.163	0.029*	−0.055	0.087
CO	−0.062	0.032	−0.308	0.038*	−0.050	0.073
ID	0.042	0.064	−0.030	0.075	−0.252	0.266
NM	0.069	0.051	−0.393	0.061*	−0.171	0.206
NV	−0.023	0.040	−0.297	0.046*	−0.023	0.077
OK	−0.037	0.050	−0.296	0.051*	−0.444	0.101*
TX	0.136	0.011*	−0.155	0.014*	−0.115	0.023*
UT	0.034	0.050	−0.151	0.053*	−0.051	0.084
Northeast						
MA	−0.015	0.168	−0.359	0.168	0.168	0.053
MD	−0.113	0.115	−0.356	0.080*	−0.249	0.041*
NY	−0.050	0.057	−0.119	0.036*	−0.108	0.025*
PA	−0.099	0.087	−0.304	0.069*	−0.216	0.069*

Source US Natality File 2014–2016

$N = 6{,}823{,}979$

Notes: Models control for maternal education, maternal age at birth, parity, plurality, adequacy of prenatal care, and birth year

*$p < 0.01$

Table 6 Results from decomposition of residual and smoking-mediated (indirect) effects of ethnicity on low birthweight, stratified by state (log odds/logits)

	MX US				MX FB				C/S FB			
	Residual		Smoking		Residual		Smoking		Residual		Smoking	
	Logit	SE	Logit	SE	Logit	SE	Logit	SE	Logit	SE	Logit	SE
Pacific												
CA	0.181	0.013*	−0.032	0.002*	0.107	0.014*	−0.040	0.002*	0.212	0.024*	−0.037	0.002*
OR	0.112	0.047	−0.096	0.013*	0.147	0.051*	−0.159	0.015*	0.339	0.124*	−0.126	0.014
WA	0.094	0.038	−0.071	0.008*	−0.034	0.041	−0.116	0.010*	0.251	0.079*	−0.095	0.009*
Southeast												
AL	−0.100	0.096	−0.100	0.012*	−0.386	0.063*	−0.159	0.014*	−0.544	0.081*	−0.178	0.015*
AR	0.050	0.075	−0.104	0.015*	−0.110	0.065	−0.174	0.017*	−0.240	0.120	−0.177	0.018*
FL	0.047	0.035	−0.089	0.007*	−0.252	0.035*	−0.146	0.007*	−0.176	0.022*	−0.135	0.007*
KY	−0.076	0.103	−0.093	0.016*	−0.382	0.083*	−0.265	0.018*	−0.398	0.115*	−0.265	0.018*
LA	0.108	0.095	−0.052	0.012*	−0.249	0.084*	−0.128	0.014*	−0.314	0.065*	−0.134	0.014*
NC	0.009	0.047	−0.113	0.009*	−0.299	0.036*	−0.197	0.011*	−0.310	0.045*	−0.179	0.010*
SC	0.020	0.091	−0.081	0.011*	−0.321	0.066*	−0.161	0.015*	−0.455	0.086*	−0.147	0.014*
TN	−0.009	0.069	−0.114	0.012*	−0.401	0.053*	−0.218	0.014*	−0.334	0.066*	−0.222	0.014*
Midwest												
IA	0.124	0.071	−0.094	0.014*	0.084	0.080	−0.167	0.017*	0.118	0.114	−0.180	0.018*
IL	0.096	0.025*	−0.120	0.008*	−0.032	0.027	−0.165	0.009*	−0.010	0.061	−0.132	0.008*
IN	0.040	0.049	−0.105	0.011*	−0.156	0.049*	−0.188	0.012*	−0.106	0.088	−0.178	0.012*
KS	0.015	0.055	−0.089	0.013*	−0.290	0.066*	−0.143	0.015*	−0.173	0.112	−0.146	0.016*
MI	0.091	0.047	−0.080	0.010*	−0.212	0.061*	−0.165	0.011*	−0.307	0.110*	−0.147	0.011*
MN	0.109	0.071	−0.081	0.010*	0.112	0.071	−0.145	0.014*	−0.060	0.102	−0.133	0.013*
MO	−0.125	0.073	−0.097	0.013*	−0.008	0.075	−0.228	0.015*	0.001	0.101	−0.221	0.101*
NE	0.080	0.071	−0.080	0.014*	−0.043	0.079	−0.140	0.018*	−0.068	0.105	−0.155	0.020*
OH	0.112	0.056	−0.081	0.010*	−0.230	0.074*	−0.217	0.012*	−0.066	0.074	−0.212	0.011*

Table 6 (continued)

	MX US				MX FB				C/S FB			
	Residual		Smoking		Residual		Smoking		Residual		Smoking	
	Logit	SE	Logit	SE	Logit	SE	Logit	SE	Logit	SE	Logit	SE
WI	0.091	0.058	−0.100	0.014*	−0.117	0.061	−0.192	0.016*	0.002	0.145	−0.134	0.015*
Southwest/Mountain												
AZ	0.119	0.024*	−0.056	0.007*	−0.058	0.030	−0.079	0.007*	0.045	0.087	−0.073	0.007*
CO	0.023	0.032	−0.064	0.010*	−0.140	0.039*	−0.127	0.011*	0.094	0.073	−0.104	0.011*
ID	0.166	0.008	−0.096	0.021*	0.183	0.077	−0.166	0.023*	−0.113	0.268	−0.102	0.021*
NM	0.139	0.052*	−0.055	0.015*	−0.282	0.063*	−0.086	0.018*	−0.077	0.207	−0.071	0.016*
NV	0.074	0.041	−0.071	0.011*	−0.170	0.048*	−0.092	0.012*	0.094	0.078	−0.084	0.012*
OK	0.056	0.050	−0.076	0.011*	−0.137	0.052*	−0.128	0.013*	−0.278	0.102*	−0.133	0.013*
TX	0.196	0.012*	−0.048	0.003*	−0.080	0.014*	−0.060	0.003*	−0.038	0.023*	−0.061	0.003*
UT	0.096	0.051	−0.042	0.008*	−0.026	0.053	−0.086	0.010*	0.033	0.084	−0.053	0.009*
Northeast												
MA	0.046	0.168	−0.043	0.013*	−0.223	0.169	−0.101	0.014*	0.049	0.054	−0.140	0.016*
MD	0.014	0.116	−0.097	0.013*	−0.103	0.081	−0.192	0.016*	0.010	0.043	−0.194	0.016*
NY	0.080	0.057	−0.102	0.007*	0.070	0.037	−0.148	0.008*	0.057	0.026	−0.128	0.007*
PA	0.036	0.088	−0.112	0.011*	−0.036	0.070	−0.209	0.012*	0.018	0.069	−0.177	0.012*

Source US Natality File 2014–2016

$N = 6,823,979$

Notes Karlson, Holm, and Breen decompositions control for maternal education, maternal age at birth, parity, plurality, adequacy of prenatal care, and birth year. See Fig. 3 for visual display. For each state, smoking is a statistically significant mediator for ethnicity and low birthweight. Standard errors for indirect effects are obtained using the delta method (Sobel 1987)

$^*p < 0.01$

Table 7 Logit regression of low birthweight on states and select covariates, stratified by ethnicity–nativity (log odds/logits)

	White US		MX US		MX FB		C & S FB	
	Logit	SE	Logit	SE	Logit	SE	Logit	SE
State (CA)								
Pacific								
OR	0.024	0.017	0.010	0.043	0.062	0.043	0.145	0.124
WA	−0.052	0.014*	−0.058	0.035	−0.105	0.036*	0.052	0.080
Southeast								
AL	0.374	0.015*	0.162	0.094	0.052	0.057	−0.110	0.077
AR	0.173	0.017*	0.134	0.073	0.054	0.058	−0.199	0.117
FL	0.146	0.011*	0.093	0.034*	−0.048	0.033	−0.109	0.029*
KY	0.390	0.013*	0.168	0.102	−0.053	0.080	−0.139	0.115
LA	0.334	0.015*	0.322	0.093*	0.127	0.080	−0.033	0.063
NC	0.328	0.012*	0.223	0.045*	0.065	0.031	−0.081	0.047
SC	0.267	0.015*	0.186	0.089	0.022	0.059	−0.229	0.084*
TN	0.238	0.013*	0.127	0.068	−0.104	0.048	−0.124	0.066
Midwest								
IA	0.156	0.016*	0.161	0.068	0.040	0.073	0.057	0.111
IL	0.187	0.012*	0.108	0.023*	0.045	0.023	−0.052	0.063
IN	0.262	0.012*	0.182	0.049*	0.010	0.047	−0.030	0.089
KS	0.229	0.017*	0.123	0.050	−0.086	0.059	0.022	0.109
MI	0.188	0.012*	0.171	0.046*	−0.030	0.059	−0.251	0.111
MN	0.048	0.014*	0.008	0.068	0.008	0.064	−0.218	0.099
MO	0.218	0.013*	−0.033	0.072	0.099	0.072	0.010	0.101
NE	0.118	0.020*	0.061	0.065	0.005	0.067	−0.090	0.095
OH	0.208	0.011*	0.233	0.056*	−0.075	0.073	−0.008	0.076
WI	0.122	0.014*	0.074	0.055	−0.186	0.056*	−0.134	0.143
Southwest/Mountain								
AZ	0.128	0.015*	0.108	0.019*	0.021	0.025	0.008	0.088
CO	0.427	0.014*	0.318	0.029*	0.203	0.033*	0.308	0.074*
ID	0.174	0.021*	0.187	0.060*	0.214	0.067*	−0.185	0.264
NM	0.411	0.028*	0.402	0.041*	0.055	0.049	0.136	0.205
NV	0.215	0.022*	0.140	0.033*	−0.010	0.038	0.149	0.076
OK	0.201	0.016*	0.172	0.048*	0.097	0.047	−0.135	0.101
TX	0.194	0.010*	0.248	0.012*	0.075	0.014*	0.013	0.031
UT	0.274	0.015*	0.269	0.047*	0.230	0.046*	0.121	0.085
Northeast								
MA	0.111	0.015*	−0.019	0.167	−0.229	0.166	−0.024	0.050
MD	0.076	0.017*	−0.069	0.114	−0.050	0.075	−0.034	0.037
NY	0.057	0.011*	−0.008	0.056	0.046	0.034	−0.078	0.030
PA	0.136	0.011*	0.060	0.087	−0.045	0.069	−0.091	0.071
Obs.	5,049,356		788,709		716,922		268,992	

Source US Natality File 2014–2016

$N = 6,823,979$

Notes Models control for maternal education, maternal age at birth, parity, plurality, adequacy of prenatal care, and birth year

$*p < 0.01$

Table 8 Frequency of births by ethnicity and state

	W-US	M-US	M-FB	CS-FB	Total	Hispanic
Pacific						
CA	357,863	273,205	232,050	37,804	900,922	543,059
OR	90,757	10,397	10,804	1086	113,044	22,287
WA	149,913	15,929	17,312	2769	185,923	36,010
Southeast						
AL	104,128	1839	5793	3151	114,911	10,783
AR	74,713	3023	5340	1571	84,647	9934
FL	269,278	15,066	20,101	50,623	355,068	85,790
KY	134,882	1593	3136	1478	141,089	6207
LA	97,260	1728	2809	5016	106,813	9553
NC	193,065	7955	20,881	10,928	232,829	39,764
SC	97,172	2029	5595	3097	107,893	10,721
TN	157,156	3445	8944	4497	174,042	16,886
Midwest						
IA	93,942	3726	3684	1437	102,789	8,847
IL	228,701	38,565	41,666	5166	314,098	85,397
IN	185,586	6963	9104	2298	203,951	18,365
KS	81,346	7177	6264	1515	96,302	14,956
MI	217,979	7860	5668	1698	233,205	15,226
MN	143,116	4045	4934	2381	154,476	11,360
MO	164,583	3642	3361	1710	173,296	8713
NE	56,186	4183	4207	2089	66,665	10,479
OH	298,243	5061	3900	3176	310,380	12,137
WI	142,931	5881	7340	974	157,126	14,195
Southwest/Mountain						
AZ	105,480	56,900	34,118	2458	198,956	93,476
CO	115,530	17,881	15,937	2670	152,018	36,488
ID	51,892	4675	3695	324	60,586	8694
NM	20,477	8381	7637	372	36,867	16,390
NV	40,501	15,989	13,830	2719	73,039	32,538
OK	95,983	7071	8571	1941	113,566	17,583
TX	391,818	236,960	175,620	37,028	841,426	449,608
UT	113,060	7127	7953	2466	130,606	17,546
Northeast						
MA	114,453	668	831	8,920	124,872	10,419
MD	89,659	1452	3386	19,181	113,678	24,019
NY	295,375	6009	18,168	42,484	362,036	66,661
PA	276,328	2284	4283	3965	286,860	10,532
Total	5,049,356	788,709	716,922	268,992	6,823,979	1,774,623

Notes Hispanic refers to the total numbers of US-born Mexican and foreign-born Mexican or Central or South American births. Births from other Hispanic ethnic-nativity groups are not included in these counts

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