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Intergenerational Change in Birthweight
Effects of Foreign-born Status and Race/Ethnicity

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Background: Foreign-born women have heavier infants than US-born women, but it is unclear whether this advantage persists across generations for all races and ethnicities.

Methods: Using 1971–2015 Florida birth records, we linked records of female infants within families to assess intergenerational changes in birthweight and prevalence of low birthweight by grandmother's race/ethnicity and foreign-born status. We also assessed educational gradients in low birthweight in two generations.

Results: Compared with daughters of US-born black women, daughters of foreign-born black women had substantially higher birthweights (3,199 vs. 3,083 g) and lower prevalence of low birthweight (7.8% vs. 11.8%). Daughters of foreign-born Hispanic women had moderately higher birthweights (3,322 vs. 3,268 grams) and lower prevalence of low birthweight (4.5% vs. 6.2%) than daughters of US-born Hispanic women. In the next generation, a Hispanic foreign-origin advantage persisted in low birthweight prevalence (6.1% vs. 7.2%), but the corresponding black foreign-origin advantage was almost eliminated (12.2% vs. 13.1%). Findings were robust to adjustment for sociodemographic and medical risk factors. In contrast to patterns for other women, the prevalence of low birthweight varied little by maternal education for foreign-born black women. However, a gradient emerged among their US-born daughters.

Conclusions: The convergence of birthweight between descendants of foreign-born and US-born black women is consistent with theories positing that lifetime exposure to discrimination and socioeconomic inequality is associated with adverse health outcomes for black women. The emergence of a distinct educational gradient in low birthweight prevalence between generations underscores hypothesized adverse effects of multiple dimensions of disadvantage.

Keywords: Birthweight; Disparity; Ethnicity; Foreign-born; Low birthweight; Race

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Racial disparities in birth outcomes have been documented in the United States for decades. In 1977–1979, the infant mortality rate for black infants (23 per 1,000 live births) was about twice as high as for white infants (12 per 1,000 live births); similarly, the prevalence of low birthweight (less than 2,500 g) among black infants (13%) was over twice as high as among white infants (6%).[1] In the intervening years, there has been little progress in narrowing these disparities. In 2014, black women had the highest prevalence of low birthweight births of all racial groups at 13%, compared with 7% of births to white and Hispanic women.[2] These disparities obscure substantial heterogeneity in birth outcomes by foreign-born status. Studies have repeatedly demonstrated that foreign-born women have heavier infants than US-born women of the same race/ethnicity, and this healthy immigrant effect is especially large among black women.[3–13] Although studies have found that the foreign-origin birthweight advantage declines in subsequent generations among Hispanics,[14–16] less is known about its persistence among descendants of black immigrants. Because studies of birth outcomes among immigrants and their descendants in the United States and elsewhere have relied on limited cross-sectional data, their inferences about birthweight disparities by foreign-born status and duration of stay in the host country may have been confounded by potential changes in the immigrant population. A more informative approach is to compare birth outcomes across generations within families, a strategy that mitigates concerns about such immigrant selection.

In a seminal study, Collins et al.[5] (2002) tested whether birthweight declined across generations within families, using 41 years of Illinois birth records. Although black immigrant

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IRB statement: Our study was approved by the Institutional Review Boards of Princeton University and the Florida Department of Health. All conclusions are the authors' own and do not necessarily reflect the views of the Florida Department of Health.

Data Sharing: Data used in this study are not available because these data are confidential and available only through a data use agreement with the Florida Department of Health. Code is available upon request.

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women gave birth to female infants with a sizeable birthweight advantage compared with US-born black women, this advantage diminished in the subsequent generation. These findings have since been marshalled as evidence that lifetime exposure to discrimination is associated with adverse health outcomes. These conclusions were based on only 104 infants whose grandmothers were black immigrants, and few characteristics of immigrants were available. Moreover, the black immigrants in their study, Illinois residents between 1956 and 1975, are not representative of black immigrants to the United States. Because black Caribbean immigrants, who until recently constituted the majority of black immigrants, are geographically concentrated, with only 10% living outside the Northeast or Florida, and because immigration flows have changed after the 1965 Immigration and Nationality Act,[17–19] it is important to reexamine whether the intergenerational patterns identified by Collins et al.[5] generalize to larger samples, more recent time periods, and other locations.

The main objective of our study is to extend earlier work of Collins and colleagues[5] by analyzing intergenerational changes in birthweight by foreign origin for black women, using a large sample of birth records in Florida. We include both non-Hispanic white and Hispanic white women for comparison to help us understand whether the trajectory for black immigrants is unique.

In an effort to obtain insight into potential factors underlying intergenerational changes in birthweight, we also examine education gradients in low birthweight prevalence by generation and race/ethnicity. Previous research has demonstrated that foreign-born women exhibit flatter education gradients in adverse birth outcomes, which could reflect both positive health selection of less-educated immigrants and lower returns to education for more-educated immigrants.[3,20] An unanswered question is whether these muted gradients persist in future generations that receive their education in the United States.

METHODS

Study Population

Data comprise birth records for Florida births between 1971 and 2015, obtained from the Birth Master Dataset provided by the Bureau of Vital Statistics of the Florida Department of Health. Use of these data was approved by the Institutional Review Boards of Princeton University and the Florida Department of Health.

We define three female generations as follows: grandmother generation (G1)—women who give birth between 1971 and 1995; mother generation (G2)—female infants born between 1971 and 1995; and daughter generation (G3)—female infants born between 1989 and 2015 to women born in Florida between 1971 and 1995. Although we construct only two generations of birth records (G2 and G3), we are able to extract information for three generations (G1, G2, and G3) because these records contain information about both infant and mother. We linked birth records between G2 and G3 by the mother's date of birth, first, middle, and last (maiden) name, using fastLink, a probabilistic matching package in R,[21] which overcomes minor measurement errors (missing middle names, misspellings, etc.) common in administrative records.[22] Of the 1,435,676 infants born between 1989 and 2015 with a mother born in Florida between 1971 and 1995, 1,372,288 (95.6%) were linked to their mothers' birth records. The records were then restricted to female singleton births born to mothers at least age 15, whose grandmothers reported white or black race, and to records with nonmissing covariates (described below). The final sample comprises 454,468 G3 births born to 330,343 G2 mothers; sample sizes by race/ethnicity, foreign-born status, and generation are shown in Table 1. Details regarding the linkage and analytic sample creation can be found in eAppendix 1; http://links.lww.com/EDE/B687 and eFigure 1; http://links.lww.com/EDE/B687.

Measures

The outcomes of interest are birthweight (in grams) and low birthweight (<2,500 g); these data are available for the entire period and can be compared across generations. Because the clinical estimate of gestational age is available only after 1979, we do not examine prematurity status.

The primary explanatory variable is G1 race/ethnicity combined with foreign-born status, which we refer to as REF, measured in six categories: US-born white, foreign-born white, US-born Hispanic, foreign-born Hispanic, US-born black, and foreign-born black. Maternal race is recorded on the birth records in all years. Because Hispanic ethnicity is unavailable before 1989, we imputed it for white women based on G1 maiden name frequency in the 2010 census using the "wru" package in R.[23] Hispanic ethnicity was not imputed for black women because foreign-born black women often had maiden names that were too rare to appear in the census surname tabulations, and external census and Current Population Survey (CPS) data suggest that the majority of both US-born and foreign-born black Florida residents during these years were non-Hispanic.[24,25] Race/ethnicity is categorized as non-Hispanic white, Hispanic white, and black, but, for simplicity, we use the terms white, Hispanic, and black. Florida birth records indicate whether the mother was born in the United States, a US territory, Canada, Cuba, Mexico, or a single category for all other foreign countries, so we can determine G1 foreign-born status but not country of birth for all G1 women. We classify women born in Puerto Rico or the Virgin Islands as US-born (N = 3,122 G2 births, 4,178 G3 births). Census and CPS data from 1970 to 1995 reveal that between 74% and 90% of the foreign-born black Florida residents reported a Caribbean birthplace, most commonly Jamaica or Haiti, whereas fewer than 2% reported a birthplace in Africa.[24,25] In the same period, around three quarters of foreign-born Hispanic Florida residents were from Cuba or Mexico, whereas

TABLE 1. Summary Statistics of Intergenerational Sample by G1 Race/Ethnicity, and Foreign-Born Status

G1 Race	White					
G1 Ethnicity	Non-Hispanic		Hispanic		Black	
G1 Foreign-Born Status	US-Born	Foreign-Born	US-Born	Foreign-Born	US-Born	Foreign-Born
Characteristics from G2 birth records						
N	171,701	6,210	13,267	19,634	111,052	8,479
G1 education						
Less than high school (%)	30	22	52	41	45	60
High school (%)	46	45	32	36	42	27
Some college (%)	17	23	13	17	10	10
College (%)	7	10	4	6	2	3
G1 marital status						
Married (%)	85	87	70	81	33	42
G1 zip code characteristics						
Median household income (2015 dollars)	47,000	49,400	45,600	46,900	39,000	41,600
Percent below poverty line	14	13	18	17	23	23
Percent foreign-born	7	19	20	41	10	25
Perinatal characteristics of G2 births						
Median year of G2 birth	1982	1982	1985	1984	1982	1986
G1 received any prenatal care (%)	98	98	97	98	96	96
G1 parity at G2 birth	0.9	0.9	1.2	1.1	1.4	1.7
Characteristics from G3 birth records						
N	227,331	8,015	18,030	25,393	164,563	11,136
G2 education						
Less than high school (%)	20	14	30	18	30	16
High school (%)	35	29	38	32	45	38
Some college (%)	28	31	24	30	21	35
College (%)	17	26	9	21	5	10
G2 marital status						
Married (%)	56	58	38	52	15	24
G2 zip code characteristics						
Median household income (2015 dollars)	51,700	53,700	48,500	50,900	41,700	44,300
Percent below poverty line	15	15	19	17	23	21
Percent foreign-born	33	37	39	49	36	38
Perinatal characteristics of G3 births						
Median year of G3 birth	2008	2009	2008	2009	2006	2010
G2 age at G3 birth	25	25	23	25	23	23
G2 received any prenatal care (%)	99	99	99	100	98	98
G2 parity at G3 birth	0.8	0.7	0.9	0.6	1.2	0.8
Risk factors during G3 pregnancy						
G2 diabetes (gestational or chronic) (%)	4	4	4	3	3	3
G2 chronic hypertension (%)	1	1	1	1	2	1
G2 pregnancy-related hypertension (%)	5	5	4	4	6	5
G2 no pregnancy risk factors (%)	68	69	69	72	65	69

Data are from Florida birth records 1971–2015. Percentages may not sum to 100 due to rounding.

foreign-born white Florida residents were predominantly from Canada and Europe.[24,25] Additional details on immigrants in Florida and the Hispanic ethnicity imputation are provided in eAppendices 2-3; http://links.lww.com/EDE/B687.

Our multivariate analyses include an extensive set of covariates to assess whether the differences in birth outcomes between foreign-origin and US-origin women in each generation can be attributed to differing sociodemographic and medical risk profiles. The choice of covariates was informed by prior literature that has found that, compared with US-born mothers of the same race/ethnicity, foreign-born mothers are higher parity, older, more likely to be married at the time of

birth, have fewer health conditions during pregnancy, and live in neighborhoods with higher immigrant density, all characteristics considered protective of adverse birth outcomes.[3,8,9,26] However, foreign-born women can face barriers to accessing health care, often live in disadvantaged areas, and often have lower rates of high school completion than US-born women.[8,9,11–13,20]

Because information is limited for birth records before 1989, G1 covariates include only year, education, marital status, mailing address ZIP code variables, receipt of prenatal care, and parity (0, 1, 2, 3, and 4 or more). G2 covariates additionally include linear and quadratic terms for age at birth and risk factors during pregnancy (diabetes, chronic hypertension, pregnancy-related hypertension, other risk factors). Area-level disadvantage is captured by ZIP code-level estimates (from the closest census) of logged median household income (in 2015 dollars) and poverty rate, and immigrant density is captured by percent of the ZIP code that is foreign-born.

Statistical Analyses

We begin by documenting disparities for the REF variable in birthweight and low birthweight and examine educational gradients in low birthweight, for both G2 and G3 births. We then use multiple regression models to predict these two G2 birth outcomes from G1 REF: linear regression for birthweight and logistic regression for low birthweight. We first estimate a base model including fixed effects for G2 birth year to account for time trends. We then estimate a full model including all G1 covariates to control for differences that may underlie the observed disparities. We also include the interaction term between G1 education and G1 REF in the full model because previous research has found that the relationship between education and birth outcomes varies by REF.[3,20,27] In all models, US-born white is the reference category.

Next, we model these two outcomes in G3 by G1 REF, again using linear regression for birthweight and logistic regression for low birthweight. Like the G2 models, the G3 base model includes fixed effects for G3 birth year but adds the corresponding G2 birth outcome (birthweight or low birthweight) as a control for several reasons: regression toward the mean, floor/ceiling effects (e.g., G2 mothers who were born extremely underweight are likely to have heavier G3 infants), and intergenerational correlation of birthweight.[28,29] In the low birthweight models, we include an interaction between G1 REF and an indicator of whether the G2 birth was low birthweight. Preliminary analyses indicated that the relationship between maternal low birthweight and offspring low birthweight differed by REF, but these analyses did not reveal a similar interaction between maternal birthweight and REF; hence the interaction term is included only in the low birthweight model. We then estimate a full model adding all G1 and G2 covariates, as well as the interaction between G2 education and G1 REF, to determine the extent to which these factors attenuate the REF differences in outcomes. Analyses were done using R version 3.4.3. (R Core Team, Vienna Austria).

Because the interactions complicate interpretation of regression coefficients, we present predicted birthweights or predicted probabilities of low birthweight. Predictions are generated by holding covariates other than REF at their mean values for the entire sample; an exception is that, in the G3 models, G2 birthweight values are assigned to the mean of the respective REF group. We use predictions to assess whether disparities would differ if all REF groups had equivalent socioeconomic and medical risk profiles; for G3 models, the interest is in G3 disparities conditional on the initial G2 differences.

RESULTS

Summary statistics indicate that, in G1, foreign-born black women have lower education, higher marital rates, and higher parities than US-born black women (Table 1). Among white and Hispanic G1 women, foreign-born women have both higher educational attainment and higher marital rates. Foreign-born and US-born differences in ZIP code and perinatal characteristics are small relative to racial/ethnic differences, with white women living in the most advantaged areas and having the highest prenatal care receipt and black women living in the least advantaged areas and having the lowest prenatal care receipt. In the next generation, foreign-origin G2 women have higher education, higher marital rates, older ages at G3 birth, and lower parities than US-origin G2 women of the same race/ethnicity. As with G1 women, white women are usually the most advantaged followed by Hispanic and subsequently black women.

Intergenerational birth outcomes by G1 REF are shown in Table 2. G2 daughters of foreign-born black G1 women have a substantial advantage over those of US-born black G1 women—they are on average 116 g heavier at birth and 4 percentage points less likely to be low birthweight—although they are disadvantaged relative to daughters of Hispanic and white women. A smaller advantage is present among G2 daughters born to foreign-born Hispanic G1 women—they are on average 54 g heavier and 1.7 percentage points less likely to be low birthweight—and they have a lower prevalence of low birthweight compared with G2 daughters of US-born white G1 women. The differences in these outcomes between G2 daughters of US-born and foreign-born white G1 women are minimal. Between G2 and G3, all groups exhibit a decline in average birthweight and an increase in the prevalence of low birthweight; this trend is consistent with secular declines in birthweight on the order of 3.5 g per year that have been documented after 1990 following several decades of increases in birthweight.[30,31] Descendants of foreign-born Hispanic G1 women exhibit a 31 g steeper decline in birthweight than descendants of US-born Hispanic G1 women, with little difference (0.6 percentage points) in the intergenerational change in low birthweight prevalence. In contrast,

TABLE 2. Intergenerational Birth Outcomes by G1 Race/Ethnicity, and Foreign-Born Status

	G1 Race	All	White						Black		
	G1 Ethnicity	All	Non-Hispanic			Hispanic					
	G1 Foreign-born Status	All	US-Born	Foreign-Born	Difference (95% CI)	US-Born	Foreign-Born	Difference (95% CI)	US-Born	Foreign-Born	Difference (95% CI)
G2 births	Mean birthweight (g)	3,247	3,342	3,325	−18 (−30, −4)	3,268	3,322	54 (43, 65)	3,083	3,199	116 (104, 128)
	Low birthweight (% <2,500 g)	7.5	5.2	5.3	0.1 (−0.5, 0.6)	6.2	4.5	−1.7 (−2.2, −1.2)	11.8	7.8	−4.0 (−4.7, −3.3)
	N	330,343	171,701	6,210		13,267	19,634		111,052	8,479	
G3 births	Mean birthweight (g)	3,176	3,286	3,271	−15 (−27, −3)	3,199	3,222	23 (13, 33)	3,020	3,032	12 (1, 23)
	Low birthweight (% <2,500 g)	8.6	5.9	6.1	0.2 (−0.4, 0.7)	7.2	6.1	−1.1 (−1.6, −0.6)	13.1	12.2	−0.9 (−1.5, −0.2)
	N	454,468	227,331	8,015		18,030	25,393		164,563	11,136	
G2 to G3 change	Mean birthweight (g)	−71	−56	−54	2 (−16, 20)	−69	−100	−31 (−45, −16)	−63	−167	−104 (−120, −87)
	Low birthweight (percentage point)	1.1	0.7	0.8	0.1 (−0.7, 0.9)	1.0	1.6	0.6 (−0.1, 1.3)	1.3	4.4	3.1 (2.2, 4.1)

Data are from Florida birth records 1971–2015. Difference refers to the difference between foreign-born and US-born women in each racial/ethnic group. 95% CI refers to the 95% confidence interval for this difference.

descendants of foreign-born black G1 women exhibit a far steeper decline in birthweight (104 g) and increase in the prevalence of low birthweight (3.1percentage points) compared with descendants of US-born black G1 women. Moreover, in only one generation, the advantage of foreign-origin black women has essentially disappeared: the birthweight outcomes of their descendants have converged to those of their US-origin counterparts.

Figure 1 displays the maternal education gradients in the observed prevalence of low birthweight among G2 and G3 births; gradients adjusted for covariates in both generations are displayed in eFigure 2; http://links.lww.com/EDE/B687 and are essentially unchanged. In contrast to the other groups, among foreign-born black G1 women, the prevalence of G2 low birthweight varies little by maternal education. However, by the next generation, G3 births with foreign-born black grandmothers reveal the expected pattern of declining prevalence of low birthweight with increasing maternal education. Though prior literature has found flatter education gradients in low birthweight among Hispanic immigrants,[3] we find clear educational gradients in low birthweight in descendants of foreign-born Hispanic women in both generations. The two intergenerational patterns for foreign-born black women—deteriorating birth outcomes and an emerging gradient—are clearly related: they arise through large increases in low birthweight prevalence for the two least educated groups, a moderate increase for women with some college education and little change for women who completed college.

Results from multivariate analyses for G2 birth outcomes are presented in Table 3 in the form of predicted differences in birthweight and predicted relative probabilities of low birthweight. These predictions indicate that, within each race/ethnicity, differences between US-born and foreign-born women change only slightly from the base model to the full model. Although previous research indicates that immigrants are likely to be positively selected relative to those who remain in their home countries,[32–34] the estimates suggest that, on average, the observed characteristics of foreign-born black and Hispanic G1 women do not account for their birthweight advantages relative to their US-born counterparts.

Next, we examine the results for G3 birth outcomes. Coefficients from models predicting these outcomes are shown in eTable 2; http://links.lww.com/EDE/B687. Inclusion of all covariates attenuates, but does not nearly eliminate, the observed racial disparities. Figures 2 and 3 display predicted values from a base model and a full model adjusted for all G1 and G2 covariates. The figures indicate that, even with adjustment, (1) the G3 birth outcomes for foreign-origin black infants would have converged to those of US-origin black infants, (2) the low birthweight prevalence for foreign-origin Hispanic G3 infants would remain below that for US-origin Hispanic G3 infants, and (3) substantial black-nonblack disparities would remain, regardless of foreign origin.

Sensitivity Analyses

We performed additional analyses to test the sensitivity of our results. Because our linkage disproportionately captures younger G2 mothers, we repeated analyses on samples restricted to G2 mothers at least 20 or 25 years of age. We continue to find a foreign-born advantage for black women that essentially disappears in the subsequent generation (eTable 3; http://links.lww.com/EDE/B687). Our results are also robust to exclusion of women born in Puerto Rico and the Virgin Islands (eTable 4; http://links.lww.com/EDE/B687). Because many (29%) G2 mothers have more than one G3 birth within our data set, we estimated random effects models that account for this clustering and find that the estimates are consistent with our main results (eTable 5; http://links.lww.com/EDE/B687).

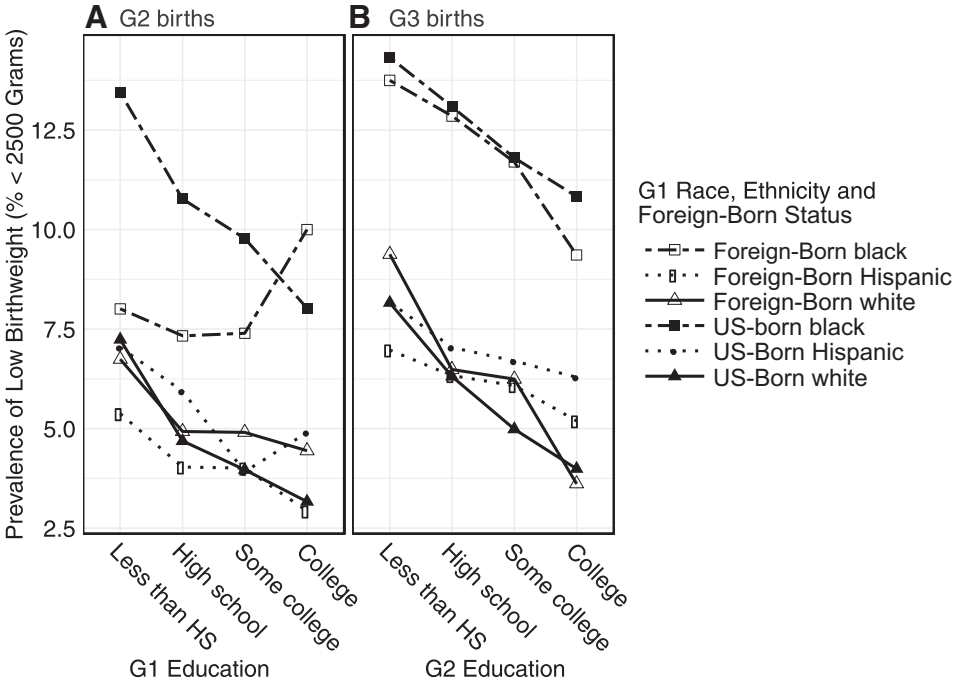

FIGURE 1. Educational gradients in the prevalence of low birthweight by G1 race/ethnicity and foreign-born status in both generations. Observed prevalence of low birthweight by mother's education in (A) G2 births and (B) G3 births.

TABLE 3. Birthweight and Low Birthweight in G2: Differences and Relative Probabilities by G1 Foreign-Born Status

	Base Model[a]		Full Model[b]	
G1 Race/Ethnicity	Birthweight (Difference in Grams)	Low Birthweight (Relative Probability)	Birthweight (Difference in Grams)	Low Birthweight (Relative Probability)
White non-Hispanic (foreign-born versus US-born)	−18 (−31, −5)	1.0 (0.90, 1.1)	−15 (−29, −1.0)	1.0 (0.90, 1.1)
White Hispanic (foreign-born versus US-born)	53 (42, 64)	0.73 (0.66, 0.80)	56 (45, 68)	0.73 (0.66, 0.81)
Black (foreign-born versus US-born)	115 (103, 126)	0.66 (0.61, 0.71)	102 (90, 116)	0.69 (0.63, 0.75)

Data are from Florida birth records 1971–2015. All differences and relative probabilities were generated by holding all covariates in the models except for race/ethnicity and foreign-born status at their mean values for the entire sample. 95% confidence intervals are indicated in parentheses.

[a]Base model includes fixed effects for G2 birth year.

[b]Full model includes fixed effects for G2 birth year, G1 education, the interaction between G1 education and G1 race/ethnicity and foreign-born status, marital status, parity, receipt of prenatal care, and the following zip code characteristics: logged median household income in 2015 dollars, percent below poverty rate, and percent foreign-born. Coefficients from these models are displayed in eTable 1.

DISCUSSION

Our results confirm a foreign-born advantage in birthweight for foreign-born black and Hispanic women compared with US-born women of the same race/ethnicity[3,4,6–13]; this foreign-born advantage among black women is not due to favorable birthweight outcomes compared with whites, but rather to adverse birthweight outcomes of US-born black women. An important contribution of our analysis is to extend the findings of Collins and colleagues[5] to a large sample of descendants of foreign-born black women in a major immigrant destination, where we identify a convergence between birthweight outcomes of foreign-born and US-born black women in only one generation. The decline is especially troubling for low birthweight, with the prevalence increasing over 50% from the second to third generation. In contrast, descendants of both US-born and foreign-born Hispanic and white women maintain relatively high birthweights and a low prevalence of low birthweight, though these outcomes did worsen between the two generations. We bolster our findings by including sociodemographic characteristics and medical risk factors not previously examined and find that the initial advantage and more severe deterioration in birth outcomes among descendants of foreign-born black women cannot be primarily attributed to differences in these features.

The decline in birthweight among descendants of foreign-born Hispanic and foreign-born black women is consistent with an extensive literature documenting a deterioration in health outcomes among immigrants with increasing duration in the United States.[35,36] Negative acculturation theory posits that recently arrived immigrants have superior

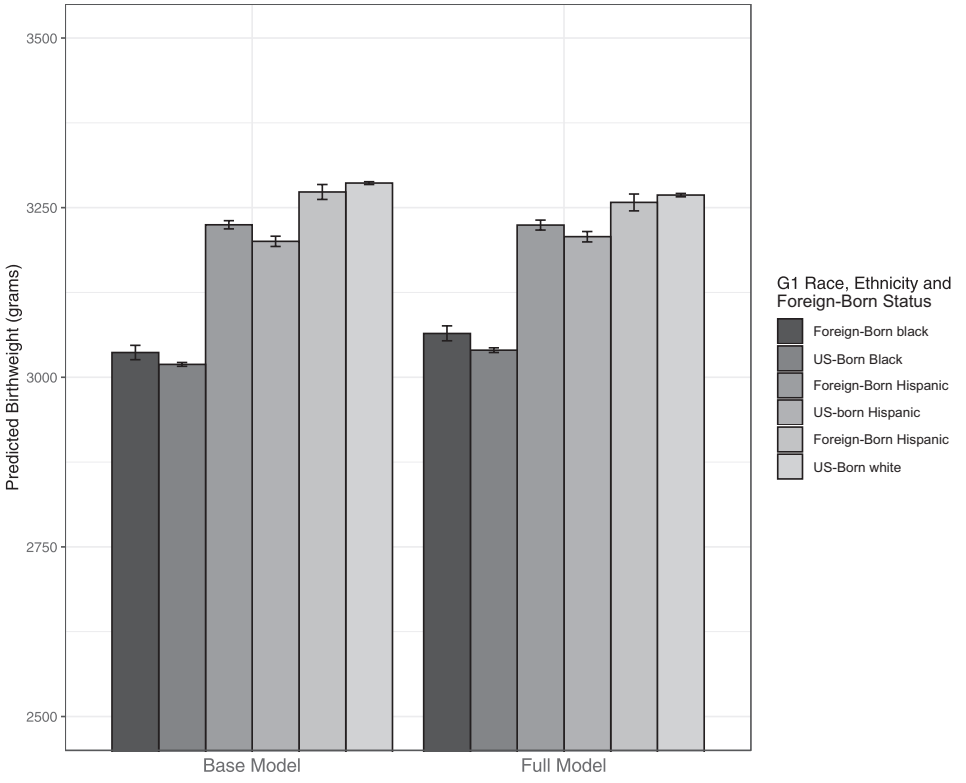

FIGURE 2. G1 Race/Ethnicity and Foreign-Born Status. Predicted birthweight in G3 by G1 race/ethnicity and foreign-born status. Predictions were generated by assigning G2 birthweight values to their group-specific means and holding all other covariates in the models except for G1 race/ethnicity and foreign-born status at their mean values for the entire sample. Coefficients from these models are displayed in eTable 2; http://links.lww.com/EDE/B687. Error bars indicate the 95% confidence interval for the prediction.

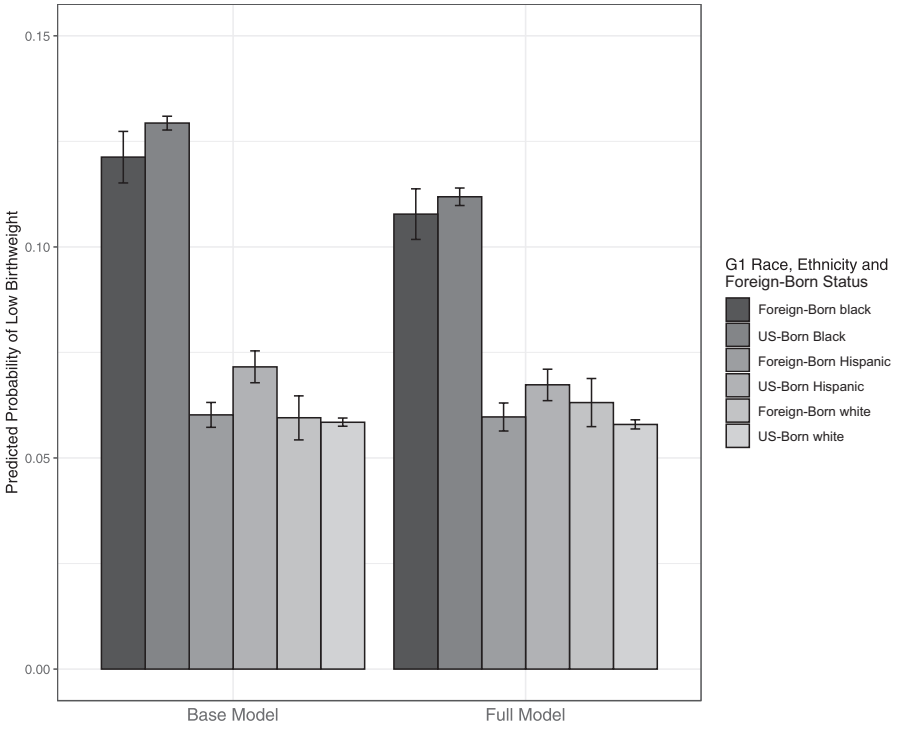

FIGURE 3. G1 Race/Ethnicity and Foreign-Born Status. Predicted probability of low birthweight in G3 by G1 race/ethnicity and foreign-born status. Predictions were generated by assigning G2 birthweight values to their group-specific means and holding all other covariates in the models except for G1 race/ethnicity and foreign-born status at their mean values for the entire sample. Coefficients from these models are displayed in eTable 2; http://links.lww.com/EDE/B687. Error bars indicate the 95% confidence interval for the prediction.

health behaviors than the US-born but adopt unhealthy behaviors (e.g., smoking, poorer diet) with duration or generation in the United States.[37] Negative acculturation may be one contributing mechanism to the intergenerational declines in birthweight among foreign-born women but does not explain why the declines are much steeper for black women.

Our findings for foreign-born black women are consistent with an emergent literature theorizing that lifetime

exposure to disadvantage, discrimination, racism, and inequality is associated with worse health outcomes for black individuals.[38,39] Whereas our covariates implicitly control for some aspects of structural discrimination and inequality—e.g., socioeconomic status is partly captured by ZIP code characteristics and poorer access to prenatal care is indirectly measured by receipt of such care—substantial black–white disparities characterize nearly all resources and exposures that are related to health. These include many factors that we cannot ascertain with these data, such as wealth, diet, quality of medical care, and exposure to environmental toxins.[39–41]

Experiences of interpersonal discrimination are likely to be an important part of the unexplained disparity between black and white women.[39–41] Discrimination is a psychosocial stressor that can trigger a physiologic stress response,[40,42] and self-reports of everyday discrimination have been associated with adverse infant outcomes including low birthweight and prematurity, as well as unfavorable adult health outcomes.[40,43,44] Researchers have hypothesized that the foreign-born advantage in birth outcomes may result from a lower lifetime exposure to discrimination.[5,45] Considerable evidence suggests that foreign-born black women encounter less prejudice than their US-born peers.[17,41,46,47] For example, foreign-born black pregnant women report less racial discrimination than US-born peers, both during their pregnancies and over their lifetimes.[46] This may result in part from their "racial context of origin," i.e., black immigrants come primarily from majority black countries, where, despite a history of structural racism, exposure to interpersonal racism appears to be less prevalent than in the United States.[18,47] This foreign-born advantage may diminish in the next generation as evidenced by second generation black children reporting similar experiences of discrimination as their peers with US-born black parents.[48] Unlike their parents, they spend their entire lives in a society that has a more racialized social structure and more deeply held attitudes of black inferiority than found in the Caribbean.[47] Though discrimination is also experienced by Hispanics in the United States, it appears to be much more prevalent among black individuals,[49,50] in line with the greater decline in birthweight observed among descendants of foreign-born black women. This deterioration of health outcomes is also consistent with the notion of "weathering," whereby cumulative exposure to disadvantage and discrimination, or stressors more generally, is associated with a premature decline in health and thereby an increased risk of adverse birth outcomes.[38]

We also show that the loss of foreign-born advantage for black women occurs together with the emergence of an education gradient in low birthweight in the third generation. This rapid appearance of stark social inequalities in birthweight may reflect the confluence of multiple dimensions of disadvantage for black children born in the United States who do not attain high levels of education. Immigrants with relatively little education (high school or less) are generally more educated than women in their home countries and likely have other advantages as well.[3] In contrast, for the children of these immigrants, low educational attainment in the United States is critically related to poor access to a wide range of resources and heightened exposure to risk factors that impact their health. Moreover, as educational attainment increased over time, women without higher education had more constricted opportunities and fewer resources than earlier generations with equivalent education.[51]

Though racial disparities in birth outcomes are no longer thought to result from genetic inheritance, they may become entrenched over generations via nongenetic mechanisms. For example, birthweight is associated with adult socioeconomic status (e.g., educational attainment and employment) and adult health conditions (e.g., hypertension and diabetes), both of which might affect fetal growth and long-term development of the subsequent generation.[28,29,52,53] Researchers have speculated that epigenetic mechanisms (e.g., DNA methylation) play an important part in how social stressors experienced by the mother produce negative birth outcomes in the next generation—and potentially in subsequent generations though not necessarily via germ cells. Although there is evidence that social stressors affect DNA methylation and that DNA methylation affects birth outcomes,[54,55] this pathway has not been sufficiently well studied, particularly among black women who are vastly underrepresented in epigenetic studies of low birthweight and prematurity.[56]

Though our study makes an important contribution to the literature on intergenerational patterns of birth outcomes, there are several limitations. The linked sample includes only female infants born between 1989 and 2015 whose mothers were born in Florida between 1971 and 1995. Though the linked sample differs demographically from the universe of all Florida births in this period, the racial, ethnic, and foreign-born status patterns in birth outcomes in the linked and unlinked samples are very similar (eTable 6; http://links.lww.com/EDE/B687). Another concern is our inability to link records for fathers and sons. Nevertheless, the racial/ethnic, foreign-born status, and generational patterns are similar for male and female births (eTable 7; http://links.lww.com/EDE/B687). An additional drawback is that data on important risk factors (e.g., maternal age, smoking) were not collected for all years and birth records may underreport maternal morbidity.[57] Last, we are unable to determine country of origin for all foreign-born G1 women, preventing us from examining the previously documented heterogeneity within the foreign-born black population.[58,59]

Our findings have important implications for understanding future racial disparities in birth outcomes. Over 20% of the growth in the black population between 2000 and 2010 was due to immigration, and by 2014, black immigrants constituted 9.2% of all black Americans and 10% of the immigrant population.[34] Black immigrants and their descendants have the potential to alter the health profile of the black population, but whether this will be a lasting change is debatable.

Indeed, in a recent article, Elo and colleagues[7] question whether relatively favorable birth outcomes among foreign-born black women can be sustained over time. Our findings suggest that these immigrant advantages in birth outcomes are unlikely to persist in future generations.

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