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Research Article

Maternal educational attainment and infant mortality in the United States: Does the gradient vary by race/ethnicity and nativity?

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Contents

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Maternal educational attainment and infant mortality in the United States: Does the gradient vary by race/ethnicity and nativity?

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Abstract

BACKGROUND
Maternal education-infant health gradients are flatter among foreign-born mothers than U.S.-born mothers; However, because common metrics of infant health are less predictive of infant mortality for some racial/ethnic and nativity groups, further study of maternal education-infant mortality gradients is necessary.

OBJECTIVE
We investigate whether maternal education–infant mortality gradients vary by race/ethnicity and nativity among infants born to mothers in the United States.

METHODS
We use data from the 1998–2002 National Vital Statistics Birth Cohort Linked Birth/Infant Death Data published by the National Center for Health Statistics (N = 17,520,140) to estimate logistic regression models predicting infant, neonatal, and postneonatal mortality by race/ethnicity and nativity.

RESULTS
The negative associations between maternal education and infant mortality are stronger for US-born mothers than foreign-born mothers. Among both groups, Non-Hispanic whites have the highest returns to education and Non-Hispanic blacks have the lowest returns. While foreign-born mothers are less likely to have an infant die than their native-born counterparts, this advantage is largest at the lowest levels of education and converges at the highest levels of education . For most racial/ethnic groups, the maternal education–infant mortality gradient is steeper during the postneonatal period than during the neonatal period.

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CONCLUSIONS
The maternal education–infant mortality gradient varies substantially by the timing of infant death, race/ethnicity, and nativity.

CONTRIBUTION
This study extends the literature on nativity disparities in infant health by documenting how the maternal education-infant mortality gradient varies by nativity within racial/ethnic groups. To our knowledge, this is the first study to produce these estimates.

1. Introduction

A large literature documents that maternal education is positively associated with favorable infant health, including lower rates of low birth weight, preterm birth, and infant mortality (Chou et al. 2010; Currie and Moretti 2003; Price, Price, and Simon 2011; Bhalotra and Rawlings 2013; Makate and Makate 2016). These findings have led researchers to focus on inequalities in maternal education as one potential pathway to improving early life survival (Prickett and Augustine 2016; Ahmed et al. 2010). Fewer studies, however, have examined whether the maternal education–infant mortality gradient is uniform across US populations; variations in this gradation would have important implications for population health over time.

This study focuses on two important sources of variation in the maternal education–infant mortality gradient: maternal nativity and race/ethnicity. In 2014, infants born to foreign-born women accounted for nearly one-quarter of all US births (Livingston 2016). Although foreign-born women, on average, have lower education levels than their US-born racial/ethnic counterparts, children born to foreign-born women have more favorable birth outcomes (e.g., lower rates of low birth weight and preterm birth) than their US-born counterparts (Hummer et al. 2007; Elo, Vang, and Culhane 2014; Green 2012; Giuntella 2017; Acevedo-Garcia, Soobader, and Berkman 2005, 2007; Janevic, Savitz, and Janevic 2011). Further, the foreign-born advantage in infant health is largest among the least educated women (Acevedo-Garcia, Soobader, and Berkman 2005; Janevic, Savitz, and Janevic 2011; Acevedo-Garcia, Soobader, and Berkman 2007).

While a number of studies identify racial/ethnic variations in the education–health gradient among US- and foreign-born adults (Goldman et al. 2006; Hayward, Hummer, and Sasson 2015; Kimbro et al. 2008; Lynch and von Hippel 2016; Montez and Barnes 2016; Montez and Friedman 2015; Montez et al. 2009; Montez et al. 2011; Sasson 2016), few studies examine the relationship between maternal education and infant

mortality, which leaves two important gaps in the extant literature. First, infant mortality is one of the most important metrics of population health (Riddell, Harper, and Kaufman 2017; Hummer et al. 1999). Researchers argue that disparities in infant mortality reflect disparities in access to medical care, income inequality, and other unequal social conditions (Olson et al. 2010; MacDorman et al. 2014). Second, prior research shows that the association between infant health (e.g., low birth weight) and infant mortality varies by race/ethnicity and nativity (Ray et al. 2009; Kierans et al. 2008). For example, Kierans and colleagues (2008) find that compared to Canadian infants born to Native Americans and mothers classified as 'other race,' those born to foreign-born Asian mothers had lower rates of perinatal mortality during the entire gestational period despite having lower average birth weight and a higher rate of being small for gestational age. This finding suggests that the maternal education–infant mortality gradient may not mirror the maternal education–infant health (e.g., low birth weight or preterm birth) gradients documented in prior studies.

We investigate whether the maternal education–infant mortality gradient varies by race/ethnicity and nativity. Specifically, using a complete sample of US births from 1998–2002, we estimate the relationships between maternal education, maternal nativity, and the probability of infant death. Given prior evidence of racial/ethnic variation in the maternal education–infant health gradient, we calculate separate estimates for non-Hispanic (NH) whites, NH blacks, Hispanics, and NH Asians.[3] Because the causes of early infant death (e.g., access to medical care) differ from the causes of later infant death (e.g., accidents), we document the associations between maternal education and three measures of infant mortality: overall infant mortality, perinatal mortality, and postneonatal mortality (Hummer et al. 2007).

2. Background

There are several mechanisms through which maternal education might influence infant health, including better access to prenatal care, better health behaviors during pregnancy, and access to economic and social resources. Currie and Moretti (2003) use US natality data combined with national data on local college availability to explore the causal effects of maternal education on infant health. The authors find that compared to mothers who had not completed high school, college-educated mothers are more likely to initiate first trimester prenatal care and are less likely to smoke. In addition, more-educated women may have better access to health information and more resources to

[3] For the remainder of the text, "white" refers to NH white, "black" refers to NH black, and "Asian" refers to NH Asian.

implement this information, which may ultimately improve infant health outcomes. Aizer and Stroud (2010) show that after the release of the Smoking and Health Report of the Advisory Committee to the Surgeon General of the Public Health Service in 1964, high school graduates were more likely than high school dropouts to reduce the intensity of their smoking during pregnancy. The authors also find that more-educated mothers experienced disproportionate decreases in rates of low birth weight and fetal deaths compared to less-educated mothers.

2.1 Variation in the link between maternal education and infant health by nativity status

While a higher level of maternal educational attainment is generally associated with better infant health,[4] the direction and magnitude of the relationships differ by maternal nativity (Acevedo-Garcia, Soobader, and Berkman 2005, 2007; Auger et al. 2008; Janevic, Savitz, and Janevic 2011; Hummer et al. 1999; Powers 2016). The 'epidemiological paradox' suggests that although some foreign-born mothers have low levels of educational attainment and often lack prenatal care, their birth outcomes (e.g., low birth weight and infant mortality) are on par with those of more-educated US mothers who are more likely to have access to medical care (i.e., white women) (Acevedo-Garcia, Soobader, and Berkman 2005, 2007; Auger et al. 2008; Janevic, Savitz, and Janevic 2011; Hummer et al. 2007; Elo, Vang, and Culhane 2014; Green 2012). Using US natality data, Acevedo-Garcia, Soobader, and Berkman (2005) find that (for all racial/ethnic groups except Asians) the foreign-born advantage in low birth weight is strongest among women with the least education (0 to 11 years). Similarly, Janevic, Savitz, and Janevic (2011) find that compared to US-born white women, the least educated foreign-born Eastern Europeans experience similar advantages with respect to low birth weight, preterm birth, and small size for gestational age. Studies using Canadian data report similar findings: Auger et al. (2008) conclude that not having a high school diploma is associated with low birth weight among Canadian-born mothers but not among foreign-born mothers. The authors also note that foreign-born status is associated with adverse birth outcomes only among the most educated mothers (those with a university degree).

Several behavioral and social factors may help explain why the association between maternal educational attainment and birth outcomes is weaker among foreign-born mothers than among US-born mothers. First, relative to their US-born counterparts, foreign-born mothers are less likely to smoke during pregnancy (Teitler,

[4] For important exceptions, see McCrary and Royer (2011) and Lindeboom, Llena-Nozal, and van der Klaauw (2009).

Hutto, and Reichman 2012). Further, while less-educated US-born women are more likely to smoke than women with greater educational attainment, foreign-born women exhibit similar smoking rates regardless of schooling levels (Kimbro et al. 2008; Goldman et al. 2006). Prior studies find that foreign-born mothers are more likely to report having social support during pregnancy, which might help mitigate the stressors typically associated with lower educational attainment and socioeconomic status (Elo and Culhane 2010; Landale, Oropesa, and Gorman 2000).

Health selection and selective return migration may also contribute to differences in the maternal education–infant health gradient between foreign- and US-born mothers. Research suggests that people who immigrate tend to be healthier than those who remain in their country of origin (Akresh and Frank 2008; Jasso et al. 2004). If foreign-born individuals are positively selected on health rather than just on educational attainment, this might weaken the link between educational attainment and infant health outcomes and result in a flatter maternal education–infant mortality gradient than might be expected otherwise. In one of the only studies examining the role of selective migration on birth outcomes, Landale, Oropesa, and Gorman (2000) find that infant mortality is much lower among recent Puerto Rican migrants to the US mainland than among women who did not migrate from the island and migrants who had resided in the United States for longer periods of time. This result provides strong evidence of selective migration among Puerto Rican women who gave birth in the United States.

2.2 Variation in the link between maternal education and infant health by race/ethnicity

In addition to the maternal education–infant health gradient being flatter for foreign-born mothers than for US-born mothers, the gradient also varies by race/ethnicity. Most research shows that the association between maternal education and infant health outcomes, such as preterm birth and infant mortality, is stronger and more significant among infants born to US-born white mothers than among infants born to US-born black mothers (Din-Dzietham and Hertz-Picciotto 1998; Braveman et al. 2015; Gage et al. 2013). In a large study of California births, Braveman et al. (2015) find no disparities between black and white mothers in preterm birth among women with less than 12 years of education but find disparities among women with at least 12 years of education. Analyzing data from mothers in North Carolina, Din-Dzietham and Hertz-Picciotto (1998) find that the risk of infant mortality among white women is 20% lower for individuals with at least a high school education than for those with less than a high school education. Among black women, however, the risk of infant mortality varies little by level of maternal educational attainment. Finally, Gage et al. (2013) report that

maternal education is weakly associated with birth outcomes among Mexican Americans relative to European and African Americans. Further, the disparity in infant mortality between European and African Americans increased with education.

While the reasons behind racial/ethnic differences in the maternal education–infant health gradient have not been fully elucidated, the ability to leverage educational attainment into access to employment and resources might be one important mechanism. Researchers argue that compared to white mothers with similar education levels, black mothers are less likely to attain commensurate benefits in income, health care, and housing (Williams 2002; Williams and Collins 2001). In a study of birth outcomes among women who spent their childhoods in poverty, Colen et al. (2006) show that among white mothers, increases in adult family income decrease the probability of low birth weight by 50% for every one unit increase in the natural logarithm of adult family income. However, there is no significant parallel relationship between changes in family income and infant health among black women.

Much of the prior work on racial/ethnic differences in the maternal education–infant health gradient fails to examine whether there are also differences between US- and foreign-born mothers (Din-Dzietham and Hertz-Picciotto 1998; Braveman et al. 2015; Gage et al. 2013). One important exception is Acevedo-Garcia, Soobader, and Berkman (2005), who show that the association between education and low birth weight is significantly stronger among US-born black women than among foreign-born black women. The authors also report that the effects of educational attainment on low birth weight are muted for white and Hispanic foreign-born women compared to their US-born counterparts. Similarly, in a study of US- and foreign-born Hispanics, Acevedo-Garcia, Soobader, and Berkman (2007) find that the educational gradient in low birth weight is steeper among the US-born mothers than among foreign-born mothers. Janevic, Savitz, and Janevic (2011) report that less-educated foreign-born white women from Eastern Europe also experience better infant health outcomes than all US-born white women.

The studies described above focus on variations in the relationship between maternal education and infant health by mother's nativity status. In comparison, few studies examine variation in the relationship between maternal education and infant mortality by nativity. Based on our review of the literature, Li and Keith (2011)'s is the only study to examine the maternal education–infant mortality (not health) gradient by nativity; however, the analysis is limited to Chinese American women. The authors find that the foreign-born advantage in infant mortality is greatest for mothers with the lowest level of education (12 or fewer years) and converges for mothers with 16 or more years of education. It is unclear whether these outcomes extend to all Asian American women or women in other racial/ethnic groups.

3. Current study

No prior studies simultaneously examine variations in the maternal education–infant mortality gradient by nativity within or across each of the major racial/ethnic groups in the United States. The current study addresses this gap in the literature by examining 1) whether the education–infant mortality gradient differs between US- and foreign-born mothers and 2) whether the slope of the gradient differs across racial/ethnic groups. Given prior evidence on infant health outcomes such as low birth weight (Acevedo-Garcia, Soobader, and Berkman 2005; Janevic, Savitz, and Janevic 2011; Acevedo-Garcia, Soobader, and Berkman 2007) and one existing study on nativity differences in the maternal education–infant mortality association among Chinese Americans (Li and Keith 2011), we conjecture that the maternal education–infant mortality gradient will be flatter among foreign-born mothers than among US-born mothers across racial/ethnic groups and that black mothers, followed by Hispanic mothers, will have the largest foreign-born advantage in infant mortality.

4. Data and methods

4.1 Data

This study uses data from the 1998–2002 National Vital Statistics Birth Cohort Linked Birth-Infant Death Data (LBID), published by the National Center for Health Statistics. The data consists of nearly the entire annual census of births and infant deaths in the United States[5] and is the largest and most complete data source on births to US- and foreign-born women. The LBID contains information on mothers' years of educational attainment and infant survival up to age one.[6] Additionally, the data contains information on prenatal behaviors such as first trimester prenatal care initiation and maternal characteristics such as age and number of prior births. Two drawbacks of the data are that it contains information on country of origin for only a few countries (Mexico and Canada) and the only socioeconomic status measure it contains is educational attainment. These limitations make it difficult to identify the extent of within-group heterogeneity in the educational gradient or the mechanisms linking maternal education to infant mortality. Nevertheless, the primary advantage of the

[5] There may be a very small number of births missing from the data (e.g., off-the-grid births), but the data is essentially complete.

[6] Because the data is cohort matched, all infants who were born during a given year but died before age one are included in a cohort, even if they died during the subsequent year (e.g., a baby who was born in 2002 but died in 2003).

LBID is that it contains data on births to US- and foreign-born women in large enough numbers to estimate racial/ethnic differences in infant mortality, which is a relatively rare outcome at the population level.

We use the most recent data available with consistent information on educational attainment across states. Ideally, we would have used more recent data (i.e., from the past five years); however, in 2003, states began to replace an earlier version of the birth certificate with a new version that captured the mother's highest completed level of education rather than her years of education (e.g., high school degree versus 12 years of education) (Martin et al. 2005). Unfortunately, the new 'level' measures of educational attainment differ across states (Martin et al. 2005). Further, while more than 70% of states had adopted the revised birth certificate by 2011[7] (the most recent year in which birth-death cohort data is available), the National Center for Health Statistics omitted information on maternal place of birth from the publicly available data between 2003 and 2013. Thus, the 1998–2002 data represents the most recent public data that allows us to consistently capture the educational attainment of all women giving birth in the United States.

4.2 Measures

The primary outcome of interest in this study is infant death during the first year of life. We examine infant death during the first month after birth (i.e., neonatal mortality) and more than a month after birth (i.e., postneonatal mortality) separately because their causes and implications are often different. Neonatal mortality is often due to factors such as congenital abnormalities and lack of access to proper medical care. In contrast, death after the first month of life is often attributable to sudden infant death syndrome and accidents, which may be more reflective of social, economic, and environmental conditions (Olson et al. 2010; MacDorman and Mathews 2010). Prior research also shows that maternal education may be more strongly associated with postneonatal mortality than neonatal mortality (Cammu et al. 2010; Chou et al. 2010). We estimate the following outcomes: neonatal mortality (0 to 27 days), postneonatal mortality (28 to 364 days), and overall infant mortality (0 to 364 days).

The main right-hand side variables of interest are educational attainment and nativity status of mothers. Prior research on adult mortality suggests that categorical measures of educational attainment provide better explanatory power than continuous measures (Everett, Rehkopf, and Rogers 2013). Following prior work (Acevedo-Garcia, Soobader, and Berkman 2005; Janevic, Savitz, and Janevic 2011; Li and Keith 2011),

[7] In 2011, 36 states as well as Washington, DC, and two territories (representing 83% of all births) had adopted the 2003 revised birth certificate (Martin et al. 2013).

we include the following indicator variables for educational attainment: 0 to 11 years of schooling (reference category), 12 years of schooling, 13 to 15 years of schooling, and 16 or more years of schooling. Maternal foreign-born status is a dichotomous variable indicating whether a mother reported being born outside the United States.

The regression models also include controls for maternal characteristics, including maternal age, marital status, and prenatal behaviors that prior research suggests may influence infant mortality and may at least partially account for the association between maternal education and infant health. Maternal age is measured as a continuous variable (in years), and we also include a nonlinear term (age squared) to allow the association between age and infant death to vary with increasing maternal age. We include a dichotomous measure of maternal marital status, which is an important predictor of infant morbidity and mortality, potentially due to differences in household resources available for child health and improved health behaviors (Buckles and Price 2013). The primary measure of prenatal behavior is whether the mother initiated prenatal care during the first trimester of pregnancy. In alternate models, we also include a measure of whether the mother smoked during pregnancy (results available upon request).[8]

Prior research shows that a child's sex and birth order influence mortality risk during the first year of life. To account for these factors, the regression models include an indicator for whether a child was male, as well as a categorical indicator of the number of prior births to the same mother (0, 1, 2, or 3 or more prior births). Lastly, the regression models include indicator variables that account for variation in infant mortality by US region of birth (Northeast, South, West, Midwest) (MacDorman, Hoyert, and Mathews 2013).

4.3 Estimation sample

The estimation sample for the study includes all singleton births that occurred to white, black, Asian, and Hispanic mothers between 18 and 46 years of age. Because of morbidity and mortality differences between singleton and multiple births, we exclude births of multiples (Mathews and MacDorman 2007). For similar reasons, we exclude pregnancies among very young and older mothers (Cavazos-Rehg et al. 2015). From the initial sample of singleton births to mothers ages 18 to 46 (n = 18,589,724), we also exclude births to mothers with missing information on race or whose reported racial/ethnic group was not one of the prespecified racial/ethnic groups of interest (n = 356,293) as well as those with missing information on nativity status (n = 44,809),

[8] We also recognize that gestational age is one of the most clinically relevant predictors of infant mortality during the first year of life. However, we do not include this variable in the main estimation models because it is strongly correlated with other maternal health behaviors and educational attainment (Powers 2016).

educational attainment (n = 218,792), birth order (n = 56,932), or trimester of prenatal care initiation (n = 381,223). We also exclude mothers who were not residents of the United States (n = 11,535). The final estimation sample consists of 17,520,140 observations. Less than 4% of the target sample had missing data on the covariates of interest. Maternal smoking is the only exception to this general pattern; approximately 18.5% of the sample had missing information on this variable. A large proportion of the observations with missing data on smoking (86%) are from California, which did not routinely collect information on smoking. Because California is an important receiving region for foreign-born citizens (López and Bialik 2017), we include these observations in the main estimation sample, which means we did not include measures of smoking in our main set of analyses. To assess the effect of including controls for smoking, we estimated models for a subset of individuals with valid information on maternal smoking (n = 14,857,143) and found similar results (results available upon request).

4.4 Summary statistics

Table 1 displays the summary statistics for the entire sample as well as by race and nativity. Table 1 shows that foreign-born white and Asian mothers have the lowest overall infant mortality rates (IMRs) (3.48 and 3.72 deaths per thousand, respectively), followed by foreign-born Hispanic mothers (4.14 deaths per thousand), US-born white mothers (4.58 deaths per thousand), US-born Hispanic mothers (5.22 deaths per thousand), and US-born Asian mothers (5.25 deaths per thousand). As expected, black mothers have the highest IMRs: 7.36 deaths per thousand for foreign-born black mothers and 11.55 deaths per thousand for US-born black mothers. Similar patterns emerge for neonatal and postneonatal deaths.

There is considerable variation in educational attainment in the study sample. Foreign-born Hispanic mothers have lower levels of educational attainment than any other racial/ethnic group. Of foreign-born Hispanic mothers, 57% report having less than 12 years of education; only 7% report having 16 or more years. US-born Hispanic mothers, on average, have more schooling than their foreign-born counterparts, with only 27% having less than 12 years of schooling and 10% having 16 or more years of education. In contrast, foreign-born black mothers are more likely than US-born black mothers to have 16 years or more of schooling (24% and 11%, respectively) and less likely than US-born black mothers to fall into the least educated category (15% and 20%, respectively). Among white women, approximately 41% and 32% of foreign- and US-born mothers, respectively, report having at least 16 years of education. Only 9% and 10% of foreign- and US-born whites have less than 12 years of schooling, respectively. Finally, Asian mothers are the most educated; 45% and 40% of foreign-

and US-born mothers, respectively, report having 16 or more years of education. In contrast, only 11% and 7% of foreign- and US-born Asian mothers, respectively, fall into the least educated category.

Table 1: Summary statistics stratified by race/ethnicity and nativity

Variables	All	NH White		NH Black		Hispanic		NH Asian	
		US-born	Foreign-born	US-born	Foreign-born	US-born	Foreign-born	US-born	Foreign-born
	n = 17,520,140	n = 10,093,743	n = 574,239	n = 2,209,892	n = 274,554	n = 1,297,741	n = 2,219,064	n = 127,099	n = 723,808
Infant mortality									
Infant mortality (birth to 1 year), per 1,000 births	5.43	4.58	3.48	11.55	7.36	5.22	4.14	5.25	3.72
Neonatal mortality (0–28 days), per 1,000 births	3.40	2.80	2.26	7.32	5.21	3.22	2.70	3.16	2.44
Postneonatal mortality (29 days to 1 year), per 1,000 births	2.04	1.78	1.22	4.26	2.16	2.00	1.44	2.09	1.29
Maternal education									
<12 years	0.19	0.10	0.09	0.20	0.15	0.27	0.57	0.07	0.11
12 years	0.33	0.32	0.27	0.43	0.37	0.41	0.26	0.29	0.23
13–15 years	0.23	0.25	0.23	0.25	0.25	0.22	0.10	0.24	0.21
16 or more years	0.26	0.32	0.41	0.11	0.24	0.10	0.07	0.40	0.45
Child characteristics									
Child male	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.52
Maternal race/foreign-born status									
Mother NH white	0.61	–	–	–	–	–	–	–	–
Mother NH black	0.14	–	–	–	–	–	–	–	–
Mother Hispanic	0.20	–	–	–	–	–	–	–	–
Mother NH Asian	0.05	–	–	–	–	–	–	–	–
Mother foreign-born	0.22	–	–	–	–	–	–	–	–
Prenatal behaviors/pregnancy characteristics									
1st trimester prenatal care	0.84	0.89	0.86	0.76	0.77	0.80	0.74	0.85	0.85
First birth	0.39	0.40	0.42	0.34	0.38	0.36	0.33	0.47	0.47
1 prior birth	0.39	0.35	0.33	0.31	0.31	0.33	0.32	0.32	0.35
2 prior births	0.34	0.16	0.15	0.19	0.18	0.19	0.21	0.14	0.12
3 or more prior births	0.17	0.09	0.09	0.16	0.13	0.12	0.15	0.08	0.06
Other maternal characteristics									
Maternal age	27.60	28.14	29.86	25.48	29.39	25.20	27.07	27.98	29.96
	(5.85)	(5.78)	(5.49)	(5.73)	(5.89)	(5.50)	(5.66)	(6.19)	(5.11)
Married	0.69	0.79	0.90	0.31	0.60	0.56	0.63	0.72	0.89
Region of birth									
Northeast	0.17	0.18	0.27	0.13	0.43	0.11	0.13	0.09	0.22
Midwest	0.22	0.29	0.18	0.21	0.08	0.09	0.10	0.09	0.13
South	0.37	0.35	0.28	0.58	0.43	0.34	0.32	0.13	0.21
West	0.24	0.18	0.26	0.08	0.07	0.46	0.45	0.70	0.43

Source: 1998–2002 Birth Cohort Linked Birth-Infant Death Data (LBID), published by the National Center for Health Statistics; all variables expressed as percentages or means (standard deviations).

Table 2 displays infant mortality rates across educational categories within each racial/ethnic nativity subgroup. The descriptive statistics suggest that educational differences in infant mortality are larger among mothers born in the United States than among foreign-born mothers – for US-born mothers moving from the lowest to the highest educational category results in an IMR reduction of approximately 67% for whites, 36% for blacks, 52% for Hispanics, and 65% for Asians. There is far less variation in IMRs across educational categories among foreign-born mothers. Among this group, moving from the lowest to the highest educational category reduces infant mortality by 47% for whites, 3% for blacks, 32% for Hispanics, and 31% for Asians.

Table 2: Infant mortality rates stratified by educational attainment, race/ethnicity, and nativity

	US-born				Foreign-born			
NH white	**Maternal education (in years)**				**Maternal education (in years)**			
	<12	**12**	**13 to 15**	**16 or more**	**<12**	**12**	**13 to 15**	**16 or more**
Infant mortality	8.53	5.53	3.99	2.85	5.16	4.23	3.27	2.74
Neonatal mortality	4.20	3.35	2.57	2.00	2.87	2.66	2.06	1.98
Postneonatal mortality	4.34	2.19	1.42	0.85	2.29	1.57	1.22	0.76
	US-born				**Foreign-born**			
NH black	**Maternal education (in years)**				**Maternal education (in years)**			
	<12	**12**	**13 to 15**	**16 or more**	**<12**	**12**	**13 to 15**	**16 or more**
Infant mortality	13.72	11.98	10.34	8.76	7.51	7.49	7.20	7.26
Neonatal mortality	7.28	7.69	7.10	6.48	4.78	5.30	5.17	5.39
Postneonatal mortality	6.49	4.32	3.26	2.29	2.74	2.20	2.04	1.88
	US-born				**Foreign-born**			
Hispanic	**Maternal education (in years)**				**Maternal education (in years)**			
	<12	**12**	**13 to 15**	**16 or more**	**<12**	**12**	**13 to 15**	**16 or more**
Infant mortality	6.48	5.28	4.54	3.12	4.41	3.97	3.84	3.01
Neonatal mortality	3.66	3.27	3.08	2.19	2.81	2.67	2.54	2.15
Postneonatal mortality	2.82	2.01	1.46	0.93	1.60	1.30	1.30	0.86
	US-born				**Foreign-born**			
NH Asian	**Maternal education (in years)**				**Maternal education (in years)**			
	<12	**12**	**13 to 15**	**16 or more**	**<12**	**12**	**13 to 15**	**16 or more**
Infant mortality	8.65	7.35	5.26	3.07	4.54	4.45	3.73	3.14
Neonatal mortality	4.38	4.03	3.54	2.08	2.87	2.75	2.46	2.17
Postneonatal mortality	4.29	3.34	1.73	0.99	1.68	1.70	1.27	0.98

Source: 1998–2002 Birth Cohort Linked Birth-Infant Death Data (LBID), published by the National Center for Health Statistics; all variables expressed as percentages or means (standard deviations).

Examining these outcomes by the timing of mortality reveals that for nearly all the focal subgroups, IMR gaps between the most and least educated mothers are smaller during the neonatal period than during the postneonatal period (e.g., 52% versus 80% for US-born white mothers). Among foreign-born black mothers, the prevailing education pattern is reversed for neonatal deaths – these deaths are somewhat higher among the most educated than among the least educated (approximately 13%) – but the

predominant pattern remains consistent with other groups for postneonatal deaths, which are 31% more likely among the least educated then among the most educated. For both neonatal and postneonatal mortality, the maternal education–infant mortality gradient varies by nativity, with steeper gradients among US-born mothers than among foreign-born mothers.

5. Methods

To study the association between maternal education and infant mortality, we estimate the following logistic regression models of infant deaths:

$$Logit(mortality_i|I_i, E_i, X) = \beta_0 + \beta_1 I_i + \beta_2 E_i + \beta_3 I_i E_i + X\beta \quad (1),$$

where $mortality_i$ represents infant, neonatal, or postneonatal mortality; I_i indicates maternal nativity; E_i represents maternal educational attainment; and $I_i E_i$ is an interaction between maternal nativity and educational attainment. Finally, *X* is a vector of additional maternal and child characteristics that are potentially related to infant mortality, including maternal age, number of previous live births, maternal marital status, whether the mother had first trimester prenatal care, sex of the child, year of birth, and region of birth. We estimate separate models for white, black, Hispanic, and Asian mothers and calculate robust standard errors clustered at the regional level due to potential correlations between observations within regions. To aid in interpretation, we provide predicted infant, neonatal, and postneonatal mortality rates calculated from these estimates.[9]

Appendix Tables A-1, A-2, and A-3 present the results from logistic regression models examining the associations between maternal education and three measures of infant mortality (overall infant, neonatal, and postneonatal) stratified by race/ethnicity. As the baseline specification, Model 1 includes only foreign-born status, education, and an interaction term between foreign-born status and education. We then estimate Model 2, which accounts for all the maternal and child characteristics listed earlier in Section 4. Regression results are expressed in coefficient form. To aid in interpretation, Table 3 shows predicted infant, neonatal, and postneonatal mortality rates based on Model 2 from Appendix Tables A-1, A-2, and A-3. We also display these results graphically by generating graphs of the infant mortality–education gradients by race and nativity (Figures 1, 2, and 3). For brevity, we only discuss the predicted probabilities from

[9] We use the STATA margins command to calculate the coefficients. This command allows us to account for the focal interaction (immigrant status x education) when predicting infant mortality outcomes (Jann 2013).

Table 3 and Figures 1 (infant mortality), 2 (neonatal mortality), and 3 (postneonatal mortality).

Table 3: Predicted infant, neonatal, and postneonatal mortality rates by educational attainment, race/ethnicity, and nativity

	US-born NH white					Foreign-born NH white				
	Maternal education (in years)					Maternal education (in years)				
	<12	12	13 to 15	16 or more	Percentage change from <12 to 16 or more years of education	<12	12	13 to 15	16 or more	Percentage change from <12 to 16 or more years of education
Infant	6.78	5.20	4.13	3.22	53%	4.42	4.05	3.31	2.91	34%
	(6.48, 7.09)	(5.11, 5.29)	(4.06, 4.20)	(3.13, 3.32)		(3.54, 5.30)	(4.03, 4.08)	(2.82, 3.79)	(2.74, 3.08)	
Neonatal	3.90	3.31	2.63	2.04	48%	2.76	2.68	2.09	1.97	29%
	(3.74, 4.06)	(3.24, 3.38)	(2.6, 2.65)	(1.97, 2.10)		(2.26, 3.27)	(2.52, 2.84)	(1.64, 2.54)	(1.79, 2.15)	
Postneonatal	2.74	1.92	1.52	1.16	58%	1.63	1.39	1.23	0.91	44%
	(2.57, 2.91)	(1.89, 1.95)	(1.45, 1.6)	(1.14, 1.19)		(1.18, 2.07)	(1.22, 1.57)	(1.06, 1.39)	(0.80, 1.02)	
	US-born NH black					Foreign-born NH black				
	Maternal education (in years)					Maternal education (in years)				
	<12	12	13 to 15	16 or more	Percentage change from <12 to 16 or more years of education	<12	12	13 to 15	16 or more	Percentage change from <12 to 16 or more years of education
Infant	13.85	12.05	10.31	8.46	39%	7.49	7.54	7.29	7.10	5%
	(13.75, 13.96)	(11.87, 12.24)	(10.08, 10.54)	(7.92, 9.00)		(6.35, 8.63)	(6.83, 8.25)	(6.91, 7.68)	(6.76, 7.43)	
Neonatal	8.27	7.96	6.76	5.27	36%	5.22	5.47	5.16	4.90	6%
	(8.13, 8.41)	(7.89, 8.03)	(6.63, 6.89)	(4.96, 5.57)		(4.21, 6.23)	(4.63, 6.32)	(4.53, 5.80)	(4.70, 5.10)	
Postneonatal	5.37	4.19	3.61	3.13	42%	2.33	2.12	2.14	2.13	9%
	(5.25, 5.50)	(4.05, 4.34)	(3.5, 3.72)	(2.87, 3.40)		(1.91, 2.74)	(1.93, 2.32)	(1.77, 2.52)	(1.59, 2.67)	
	US-born Hispanic					Foreign-born Hispanic				
	Maternal education (in years)					Maternal education (in years)				
	<12	12	13 to 15	16 or more	Percentage change from <12 to 16 or more years of education	<12	12	13 to 15	16 or more	Percentage change from <12 to 16 or more years of education
Infant	6.24	5.29	4.66	3.23	48%	4.37	4.02	3.93	3.04	30%
	(5.97, 6.5)	(5.03, 5.55)	(4.54, 4.78)	(3.07, 3.39)		(4.28, 4.45)	(3.82, 4.21)	(3.73, 4.13)	(2.78, 3.30)	
Neonatal	3.86	3.31	3.00	1.94	50%	2.87	2.68	2.47	1.93	33%
	(3.51, 4.20)	(3.21, 3.42)	(2.87, 3.12)	(1.82, 2.07)		(2.80, 2.93)	(2.53, 2.82)	(2.33, 2.62)	(1.71, 2.14)	
Postneonatal	2.35	2.00	1.67	1.29	45%	1.51	1.35	1.47	1.09	28%
	(2.31, 2.39)	(1.81, 2.20)	(1.54, 1.80)	(1.22, 1.36)		(1.45, 1.57)	(1.29, 1.41)	(1.40, 1.54)	(1.01, 1.17)	

Table 3: (Continued)

	US-born NH Asian					Foreign-born NH Asian				
	Maternal education (in years)					Maternal education (in years)				
	<12	12	13 to 15	16 or more	Percentage change from <12 to 16 or more years of education	<12	12	13 to 15	16 or more	Percentage change from <12 to 16 or more years of education
Infant	6.73	6.58	5.27	3.56	47%	4.05	4.23	3.73	3.33	18%
	(6.43, 7.03)	(3.71, 4.40)	(6.3, 6.86)	(3.94, 4.51)		(3.71, 4.40)	(3.94, 4.51)	(3.28, 4.17)	(3.16, 3.50)	
Neonatal	3.74	3.81	3.58	2.23	40%	2.70	2.70	2.49	2.21	18%
	(3.28, 4.19)	(3.56, 4.07)	(3.01, 4.16)	(1.78, 2.67)		(2.46, 2.94)	(2.56, 2.84)	(2.17, 2.8)	(2.06, 2.36)	
Postneonatal	2.87	2.73	1.71	1.34	53%	1.37	1.53	1.25	1.12	18%
	(2.63, 3.12)	(2.54, 2.92)	(1.51, 1.91)	(1.08, 1.60)		(1.16, 1.57)	(1.31, 1.75)	(1.10, 1.39)	(1.03, 1.21)	

Note: Confidence intervals in parentheses. Predicted infant mortality rates are based on Appendix Tables A-1–A-3.
Source: 1998–2002 Birth Cohort Linked Birth-Infant Death Data (LBID), published by the National Center for Health Statistics.

6. Differences in the maternal education–infant mortality gradient

To identify variations in the strength of the maternal education–infant mortality gradient, we use the results from the fully specified models for each racial/ethnic group (Model 2) to generate the predicted probabilities of infant mortality and the associated confidence intervals for the estimation sample. Based on the predicted probabilities in Table 3 (also displayed graphically in Figures 1, 2, and 3), we first examine variation in the gradient by nativity status within each of the focal racial/ethnic groups and then examine racial/ethnic variation in the gradients and the foreign-born advantage. Finally, we examine the corresponding estimates for neonatal and postneonatal mortality.

6.1 Nativity differences in the maternal education–infant mortality gradient within racial/ethnic groups

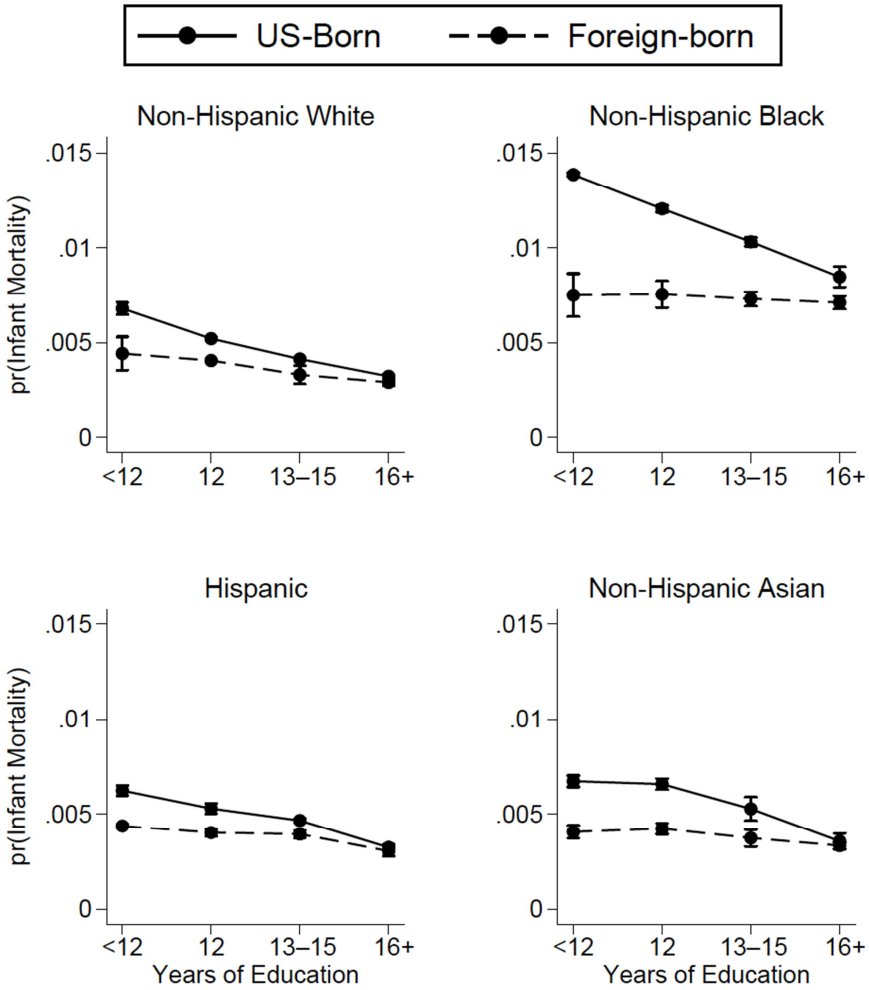
In general, we find that although the maternal education–infant mortality gradient is flatter among the foreign-born compared to the US-born, the pattern differs by race/ethnicity.

6.2 Nativity differences among white mothers

The upper left panel of Figure 1 (whites) shows that among US-born whites, the predicted IMR falls steadily as mothers' education level increases. Mothers with 16 or more years of education have an approximately 53% lower risk of giving birth to a child who dies during the first year of life than their peers with 12 or fewer years of education (approximately 3.22 deaths per thousand versus 6.78 deaths per thousand, respectively). Within most education categories, foreign-born white mothers have a lower predicted IMR than that of US-born white mothers. Moreover, compared to US-born white women, the difference in predicted IMR between the most and least educated foreign-born white women is much smaller. Foreign-born white mothers with 16 or more years of schooling have an IMR of 2.91 deaths per thousand compared to 4.42 deaths per thousand for foreign-born white mothers with 12 or fewer years of schooling, a difference of 34%. The findings also show that the nativity gap in infant mortality is largest among the least educated white women, more than 2 deaths per thousand.

The foreign-born advantage among white women decreases sharply for women with 12 years of education and those with 13 to 15 years (differences of approximately 1.15 and 0.82 deaths per thousand, respectively). Among white women with 16 or more years of schooling, there is almost no difference in infant mortality by nativity status (0.31 deaths per thousand), suggesting that birth outcomes of foreign- and US-born white women converge at the highest levels of schooling.

Figure 1: Predicted infant mortality by maternal race/ethnicity



Note: Predicted probabilities of infant mortality for the estimation sample are based on logistic regression analyses that control for maternal nativity, maternal age, marital status, maternal smoking, first trimester prenatal care, child sex, and US region of birth (Appendix: Table A-1). Regressions are estimated separately by race/ethnicity (NH Whites, n = 10,667,982; NH blacks, n = 2,484,446; Hispanics, n = 3,516,805; NH Asians, n = 850,907).
Data Source: 1998–2002 Birth Cohort Linked Birth-Infant Death Data (LBID), published by National Center for Health Statistics.

6.3 Nativity differences among black mothers

The upper right panel in Figure 1 (blacks) shows a clear downward sloping education–IMR gradient among US-born black mothers, with the most highly educated women having lower predicted mortality rates than their less-educated counterparts. Specifically, US-born black mothers with 16 or more years of schooling have a 39% lower predicted mortality rate than those with less than 12 years of schooling (13.85 deaths per thousand compared to 8.46 deaths per thousand, respectively). In contrast, the curve of predicted IMRs among foreign-born black mothers is essentially flat. While infant mortality does generally decline with increases in maternal educational attainment for foreign-born black women, the effect is quite small, a difference of only about 5% between mothers with 16 or more years of education (7.1 deaths per thousand) and those with less than 12 years of education (7.49 deaths per thousand).

The foreign-born advantage in infant mortality among black mothers is greatest for women with the least education (a difference of 6.36 deaths per thousand), followed by those with 12 years of education (4.51 deaths per thousand), and then those with 13 to 15 years of education (3.02 deaths per thousand), and is smallest for those with the most education (1.36 deaths per thousand).

6.4 Nativity differences among Hispanic mothers

The lower left panel of Figure 1 (Hispanics) displays predicted IMRs for US- and foreign-born Hispanic mothers. Like US-born whites and blacks, US-born Hispanic women also experience a clear inverse relationship between schooling and infant mortality. The overall education–infant mortality gradient among Hispanics is almost as steep as the gradient among whites. US-born Hispanic mothers with at least 16 years of education have an IMR approximately 48% lower than those with less than 12 years of education (6.24 deaths per thousand and 3.23 deaths per thousand, respectively). Like other foreign-born women, Hispanic foreign-born mothers have a relatively flat maternal education–infant mortality gradient relative to their US-born counterparts. However, there is still a 30% decline in IMR between mothers with 16 or more years of education and those with less than 12 years of education (4.37 and 3.04 deaths per thousand, respectively). This decline in infant mortality is much closer to the reduction among foreign-born white women (34%) than the one among foreign-born black women (5%). With respect to the foreign-born advantage, it is once again largest among the least educated mothers (a difference of 1.87 deaths per thousand), and falls steadily as education increases, declining to differences of approximately 1.27 and 0.73 deaths per thousand among mothers with 12 and 13 to 15 years of schooling,

respectively, and disappearing among the most educated mothers. Overall, the foreign-born advantage in infant mortality is smaller among Hispanic mothers than among black and white mothers.

6.5 Nativity differences among Asian mothers

Finally, the lower right panel of Figure 1 (Asians) displays predicted IMRs for Asian mothers. Infant mortality declines substantially with increases in education among US-born Asian mothers, just as it does among US-born white and Hispanic mothers. In the case of Asian mothers, the IMR declines by 47%, from 6.73 deaths per thousand among those with 12 years of education to 3.56 deaths per thousand among mothers with 16 or more years of education. The maternal education–infant mortality gradient for Asian mothers is flatter among the foreign-born than among US-born women, but the flattening is even more dramatic for this group than for whites or Hispanics. In fact, foreign-born black mothers are the only other group with a flatter education–infant mortality gradient than foreign-born Asians. Predicted infant mortality declines by only approximately 18% as education increases among foreign-born Asian women, from 4.05 deaths per thousand among mothers with less than 12 years of education to 3.33 deaths per thousand among those with 16 or more years of education. As with mothers in other racial/ethnic groups, the foreign-born advantage is greatest among the least educated Asian mothers (a difference of 2.68 deaths per thousand), declines slightly among those with 12 years of education (a difference of 2.35 deaths per thousand), and falls even further for those with 13 to 15 years of education (a difference of 1.54 deaths per thousand). Among Asian mothers with 16 or more years of education, the foreign-born advantage in infant mortality is not statistically significant.

6.6 Racial/ethnic differences in the maternal education–infant mortality gradient and the foreign-born advantage

In this section, we examine the same results from a slightly different perspective to highlight cross-race/ethnicity differences in both the maternal education–infant mortality gradient and the foreign-born advantage in infant mortality. Among US-born mothers, white women experience the greatest relative returns to education followed by Hispanic ones. Black and Asian mothers have the lowest returns. Among foreign-born mothers, white women again have by far the greatest returns to education, followed by Hispanic mothers. Foreign-born Asian mothers have greater returns to education than

foreign-born black mothers, who have the flattest maternal education–infant mortality gradient.

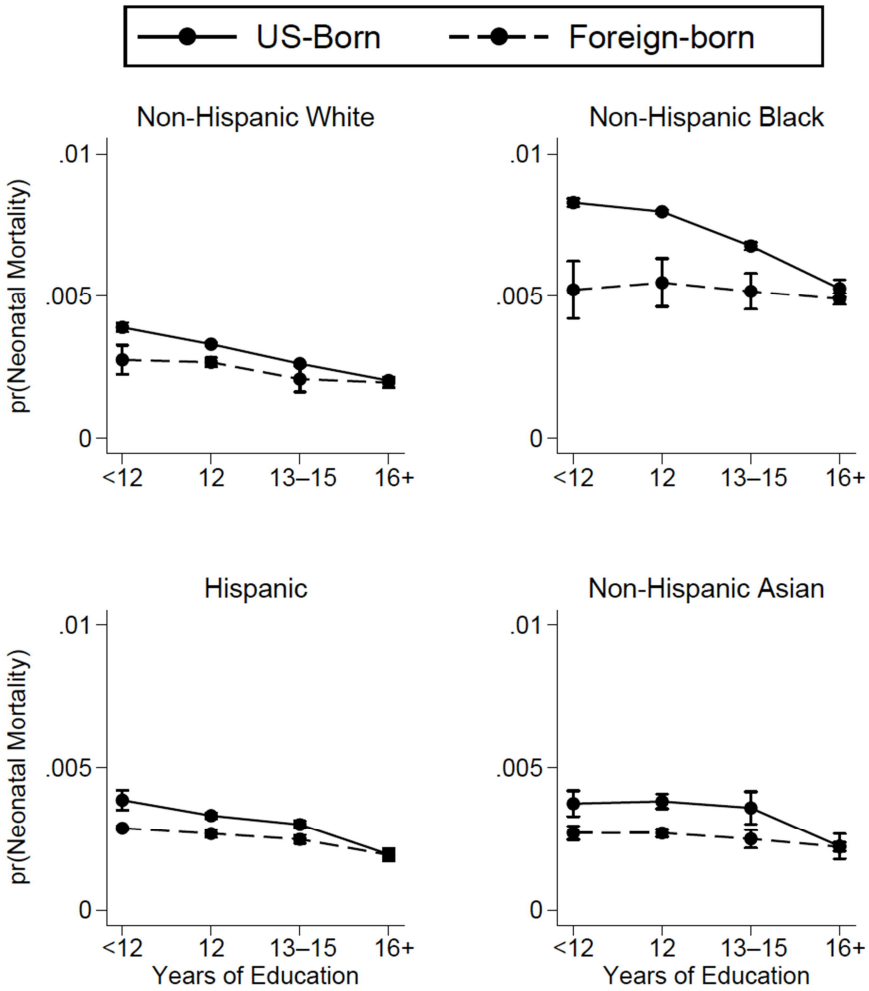
With respect to the foreign-born advantage in infant mortality, there are some similarities across the focal racial/ethnic groups as well as some differences. For all four groups of mothers (whites, blacks, Hispanics, and Asians), the foreign-born advantage is largest among the least educated women and then declines as education increases. For white, Hispanic, and Asian mothers, IMRs converge among those with the highest level of education (16 or more years), but for black mothers, the foreign-born advantage remains, albeit at a lower level, even among the most educated women. In addition, for each education category, the magnitude of the foreign-born advantage is much larger for black mothers than for white, Hispanic, or Asian mothers. Indeed, in many cases the magnitude of the foreign-born advantage is nearly twice as large for black mothers compared to the other groups.

6.7 Neonatal and postneonatal mortality

One important question is whether the maternal education–infant mortality gradient varies by the timing of infant death. Thus, we also calculated predicted gradients (see Table 3) and generated figures for neonatal (Figure 2) and postneonatal (Figure 3) mortality by race/ethnicity and nativity. In general, the observed patterns are consistent with those for overall infant mortality: For all racial/ethnic groups, the magnitude of the foreign-born advantage in both neonatal and postneonatal mortality is generally largest among the least educated women and smallest (or nonexistent) among the most educated women.

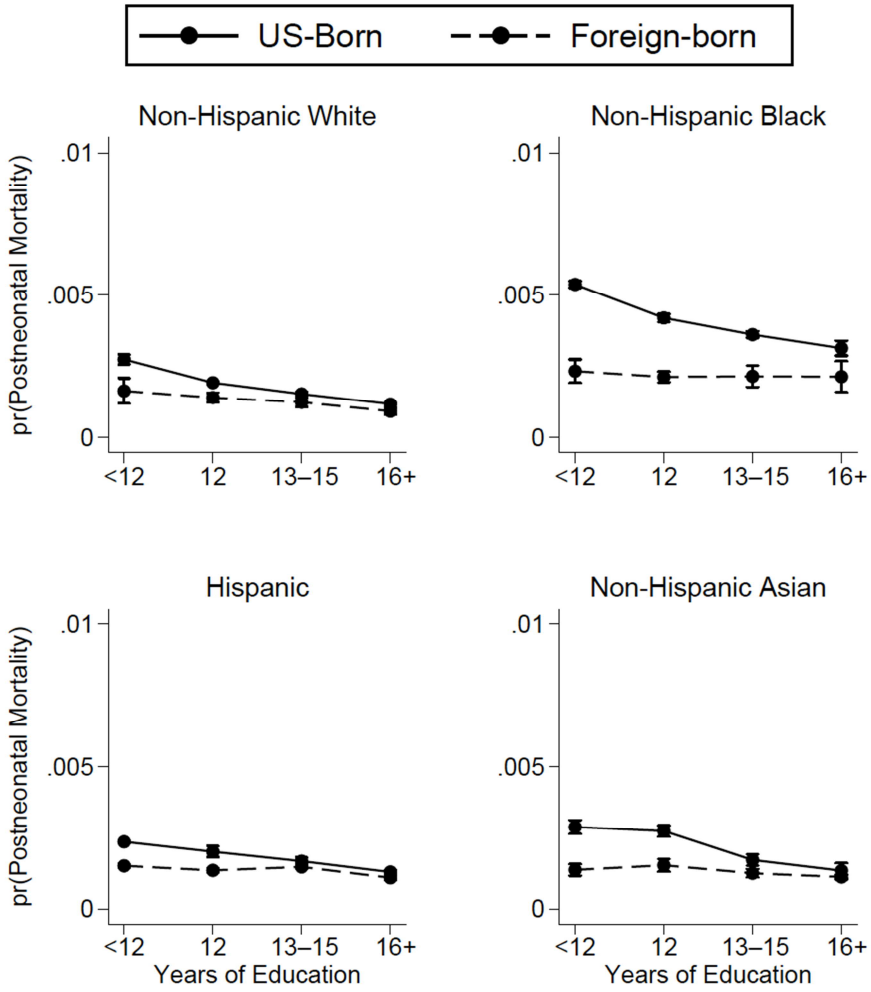
The findings reveal a notable difference between neonatal mortality and postneonatal mortality: The maternal education–neonatal mortality gradient is often flatter than the maternal education–postneonatal mortality gradient, particularly among US-born women. For example, among US-born white mothers, neonatal mortality is 48% lower among women with the most education than among those with the least education. Among the same group of women, however, predicted postneonatal mortality is 58% lower among the most educated relative to the least educated. The difference is even more pronounced among US-born Asians, where neonatal mortality declines by 40% between the most and least educated mothers, while there a 53% reduction in postneonatal mortality between these two education categories. The results are similar for black women, though the change is smaller in magnitude. Finally, US-born Hispanic women are an exception to this pattern, with the gradient for neonatal mortality being steeper than the gradient for postneonatal mortality for this group.

Figure 2: Predicted neonatal mortality by maternal race/ethnicity



Note: Predicted probabilities of neonatal mortality for the estimation sample are based on logistic regression analyses that control for maternal nativity, maternal age, marital status, maternal smoking, first trimester prenatal care, child sex, and US region of birth (Appendix: Table A-2). Regressions are estimated separately by race/ethnicity (NH Whites, n = 10,667,982; NH blacks, n = 2,484,446; Hispanics, n = 3,516,805; NH Asians, n = 850,907).
Data Source: 1998–2002 Birth Cohort Linked Birth-Infant Death Data (LBID), published by National Center for Health Statistics.

Figure 3: Predicted postneonatal mortality by maternal race/ethnicity



Note: Predicted probabilities of postneonatal mortality for the estimation sample are based on logistic regression analyses that control for maternal nativity, maternal age, marital status, maternal smoking, first trimester prenatal care, child sex, and US region of birth (Appendix: Table A-3). Regressions are estimated separately by race/ethnicity (NH Whites, n = 10,667,982; NH blacks, n = 2,484,446; Hispanics, n = 3,516,805; NH Asians, n = 850,907).
Data Source: 1998–2002 Birth Cohort Linked Birth-Infant Death Data (LBID), published by National Center for Health Statistics.

Among foreign-born mothers, we also observe differences between the gradients for neonatal mortality and postneonatal mortality. Among foreign-born white mothers, predicted neonatal mortality falls by 29% from the lowest to highest education categories while postneonatal mortality falls by 44% across the same educational difference. For black and Asian mothers, the difference between the neonatal and postneonatal gradients is small or nonexistent. Finally, among foreign-born Hispanics, the pattern is reversed: Neonatal mortality declines by 33% across education categories while postneonatal mortality is about 28% lower among those with the most education than among those with the least education.

7. Discussion and conclusion

This study contributes to the growing literature on nativity disparities in infant health by documenting how the maternal education–infant mortality gradient varies by nativity within each of the major racial/ethnic groups in the United States. To our knowledge, this is the first study to produce these estimates. Four key findings emerge from the study. First, although overall levels of infant mortality are lower among foreign-born mothers, the maternal education–infant mortality gradient is steeper among US-born mothers. Within the latter group, the gradient is steepest for US-born whites and flattest for blacks. Second, there is considerable variation in the maternal education–infant mortality gradient among foreign-born mothers. While foreign-born white and Hispanic mothers have relatively steep gradients, the gradients for foreign-born Asian and black mothers are essentially flat. Third, the relationship between maternal education and infant mortality varies by the timing of infant death for some groups, particularly for US-born mothers. Specifically, maternal education has a stronger association with postneonatal mortality than with neonatal mortality. Finally, for most racial/ethnic groups, absolute differences in infant mortality between US- and foreign-born mothers are largest at the lowest levels of education and tend to converge at the highest levels of education. The study results are generally consistent with the prior literature on nativity, education, and infant health (Acevedo-Garcia, Soobader, and Berkman 2005, 2007; Auger et al. 2008; Janevic, Savitz, and Janevic 2011; Li and Keith 2011).

While the results clearly show that both nativity and race/ethnicity influence the association between maternal education and infant mortality, the mechanisms by which this occurs remain unclear. We offer several potential explanations.[10] One potential reason that education is more strongly related to infant mortality among US-born mothers than among foreign-born mothers is that education is likely more closely

[10] Data limitations preclude the possibility of testing these explanations in the current study.

connected to income, access to resources, and behaviors that directly and indirectly influence child health, such as smoking and/or drinking for US-born mothers compared to foreign-born mothers. For example, relative to US-born individuals with the same level of education, foreign-born individuals often earn lower wages (Hamilton 2014a), which may influence their ability to translate schooling into resources that improve infant mortality outcomes.

Selective migration may also contribute to racial/ethnic differences in maternal education–infant mortality gradients among the foreign-born in the present study. For example, others find evidence that foreign-born individuals from Mexico and Central America are less positively selected on health than those from Africa and Asia (Akresh and Frank 2008) and that health selection is particularly consequential among foreign-born blacks (Hamilton and Hummer 2011; Hamilton 2014b). This cross-country variation may be one reason why foreign-born black and Asian mothers had the flattest maternal education–infant mortality gradient in our sample.

Discrimination is another plausible explanation for the weaker link between maternal education and infant mortality among US-born black mothers in particular. Discrimination-related stress is associated with worse infant health outcomes among black mothers (Dole et al. 2003; Collins et al. 2004; Dominguez et al. 2008), and unequal treatment – for example, in the labor and housing markets (Pager and Shepherd 2008) – might affect black mothers' ability to access resources related to child health, such as medical care. Further, research suggests that more-educated black women are disproportionately affected by discrimination: Collins et al. (2004) found that the links between lifetime discrimination exposure and very low birth weight were strongest among college-educated black women. Few studies have examined differences in the relationship between discrimination and infant health among US- and foreign-born black women. However, one study conducted among black pregnant women finds that foreign-born black mothers (from any region) who moved to the United States before age 18 or who are from the Caribbean are likely to report similar levels of lifetime discrimination as US-born black women, while those from Africa are likely to report lower levels (Dominguez et al. 2009). Although we cannot evaluate the role of disparate treatment in the present study, this remains an important area for further investigation.

Finally, we show that the returns to education are generally greater in the postneonatal period than in the neonatal period, a finding consistent with prior research (Chou et al. 2010; Singh and Kogan 2007; Chen, Oster, and Williams 2016). One potential explanation for this finding is that death within the first few days (or month) of life is often related to issues such as fetal abnormalities, prematurity, delivery complications, and the quality and intensity of medical care among at-risk newborns (e.g., very low birth weight) (Almond et al. 2010; Mathews, MacDorman, and Thoma

2015), while the leading causes of postneonatal mortality (sudden infant death syndrome and unintentional accidents) are likely related to factors partially outside the scope of medical care (Shapiro-Mendoza et al. 2014; Mathews, MacDorman, and Thoma 2015). If women with higher educational attainment are better able to reduce the probability of injuries or accidents (Lahr, Rosenberg, and Lapidus 2007; Goldstein et al. 2016), this could partially explain the difference between the neonatal gradient and the postneonatal gradient.

8. Limitations of the existing study

The current study has several limitations. First, while the LBID data set is one of the few sources that contain enough observations on foreign-born whites, blacks, Hispanics, and Asians to conduct the focal analyses, the data set lacks information on characteristics that might further clarify the study findings, such as maternal country of origin (Elo, Vang, and Culhane 2014) and duration of US residence (Teitler, Martinson, and Reichman 2015; Li and Hummer 2015) among foreign-born women, and maternal labor market participation, stress (e.g., discrimination), income, and wealth among all mothers. Second, the content and quality of secondary and postsecondary education as well as the degree to which educational qualifications are rewarded in the labor market vary widely by race/ethnicity and country of origin (Bratsberg and Terrell 2002; Oreopoulos 2011), but this variation is not assessed in the current analyses. Third, studies find that events such as the terrorist attacks of September 11, 2001, and subsequent anti-immigrant sentiments increased the risk of poor birth outcomes for some foreign-born groups (i.e., Arab Americans) (Lauderdale 2006; El-Sayed, Hadley, and Galea 2008). Further, changes in US immigration policy and the economic landscape (i.e., Great Recession of 2008) may have resulted in changes in fertility patterns among the foreign-born (Comolli 2017) – potentially altering the relationships between maternal education and infant health over time. While our study was unable to account for these factors, more recent data will help to clarify any changes in the maternal education–infant mortality gradient since 2002. Finally, the ability to acquire additional schooling is constrained by any number of geographic, social, and economic factors (Byun, Meece, and Irvin 2012), and thus mothers who are able to invest in more education might be positively selected on unobserved characteristics correlated with better infant health (Currie and Moretti 2003). Given this possible selection bias, any observed relationships should be interpreted as descriptive rather than causal.

Despite its limitations, this study contributes to the literature by demonstrating that the importance of educational attainment to infant mortality differs considerably by both race/ethnicity and nativity status. These findings suggest the need for further

research on the links between maternal education and infant mortality using richer and more recent sources of data, specifically more complete data sets or creative linkages between administrative data sources that allow researchers to account for the effect of selective immigration. In addition, the findings reveal serious implications for the black-white infant mortality gap in the United States. Even among the foreign-born mothers, there is a replication of the black-white infant health gap typically observed among US-born mothers. Although foreign-born black mothers demonstrate a marked infant mortality advantage relative to black US-born mothers, even the most educated have higher infant mortality rates than almost all groups of even the least educated non-black mothers. Because foreign-born black women give birth to a growing share of the black children born in the United States (Livingston and Cohn 2012), it is critically important for researchers to continue exploring the complex relationships among race/ethnicity, nativity, and infant mortality.

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Appendix

Table A-1: Logistic regression models of infant mortality stratified by race/ethnicity

	NH whites (n = 10,667,982)		NH blacks (n = 2,484,446)		Hispanics (n = 3,516,805)		NH Asians (n = 850,907)	
	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)
Mother foreign-born	–0.447*** (–0.655, –0.239)	–0.361*** (–0.573, –0.150)	–0.681*** (–0.947, –0.416)	–0.604*** (–0.770, –0.439)	–0.376*** (–0.447, –0.306)	–0.366*** (–0.436, –0.297)	–0.496*** (–0.607, –0.385)	–0.389*** (–0.424, –0.355)
Maternal age	–0.189*** (–0.201, –0.177)	–0.151*** (–0.167, –0.134)	–0.017 (–0.042, 0.007)	0.025 (–0.006, 0.056)	–0.169*** (–0.182, –0.157)	–0.139*** (–0.160, –0.117)	–0.237*** (–0.315, –0.159)	–0.192*** (–0.275, –0.108)
Maternal age^2	0.003*** (0.003, 0.003)	0.003*** (0.002, 0.003)	0.001** (0.000, 0.001)	–0.000 (–0.001, 0.001)	0.003*** (0.003, 0.003)	0.003*** (0.002, 0.003)	0.004*** (0.003, 0.005)	0.003*** (0.002, 0.005)
Maternal education								
12 years	–0.372*** (–0.411, –0.333)	–0.268*** (–0.316, –0.219)	–0.155*** (–0.177, –0.133)	–0.141*** (–0.149, –0.133)	–0.191*** (–0.224, –0.158)	–0.166*** (–0.220, –0.111)	–0.076*** (–0.120, –0.032)	–0.023 (–0.051, 0.005)
13–15 years	–0.658*** (–0.717, –0.599)	–0.499*** (–0.560, –0.439)	–0.328*** (–0.381, –0.276)	–0.299*** (–0.328, –0.270)	–0.330*** (–0.341, –0.319)	–0.293*** (–0.324, –0.262)	–0.353*** (–0.455, –0.252)	–0.246*** (–0.371, –0.120)
16+ years	–0.980*** (–1.048, –0.912)	–0.748*** (–0.817, –0.680)	–0.543*** (–0.658, –0.428)	–0.499*** (–0.571, –0.426)	–0.733*** (–0.837, –0.629)	–0.662*** (–0.728, –0.595)	–0.847*** (–0.997, –0.697)	–0.641*** (–0.790, –0.491)
Foreign-born* Education								
Foreign-born, 12 years	0.202* (–0.003, 0.407)	0.180* (–0.023, 0.384)	0.155 (–0.077, 0.387)	0.147 (–0.070, 0.365)	0.092** (0.012, 0.172)	0.082* (–0.007, 0.171)	0.075 (–0.023, 0.174)	0.065 (–0.028, 0.159)
Foreign-born, 13–15 years	0.250*** (0.075, 0.424)	0.208** (0.028, 0.388)	0.284** (0.034, 0.533)	0.272** (0.046, 0.498)	0.194*** (0.117, 0.271)	0.188*** (0.106, 0.271)	0.200*** (0.172, 0.228)	0.162*** (0.072, 0.251)
Foreign-born, 16+ years	0.397*** (0.210, 0.584)	0.328*** (0.150, 0.507)	0.469*** (0.220, 0.717)	0.443*** (0.242, 0.645)	0.315*** (0.176, 0.454)	0.298*** (0.160, 0.435)	0.539*** (0.467, 0.612)	0.443*** (0.312, 0.574)
Mother married		–0.293*** (–0.353, –0.234)		–0.142*** (–0.188, –0.096)		–0.162** (–0.287, –0.037)		–0.297*** (–0.374, –0.220)
Child characteristics								
Child male		0.219*** (0.198, 0.240)		0.192*** (0.174, 0.209)		0.179*** (0.170, 0.189)		0.117*** (0.056, 0.178)
1 prior birth		–0.048* (–0.100, 0.003)		–0.265*** (–0.300, –0.230)		–0.121*** (–0.212, –0.031)		–0.068* (–0.138, 0.002)
2 prior births		0.080*** (0.022, 0.138)		–0.217*** (–0.254, –0.180)		–0.106** (–0.211, –0.002)		0.046 (–0.070, 0.162)
3 or more prior births		0.280*** (0.210, 0.349)		–0.095*** (–0.126, –0.065)		0.059 (–0.036, 0.154)		0.235*** (0.103, 0.366)
1st trimester prenatal care		–0.245*** (–0.288, –0.202)		–0.106*** (–0.129, –0.082)		–0.061*** (–0.088, –0.034)		–0.111*** (–0.164, –0.058)

Table A-1: (Continued)

	NH whites (n = 10,667,982)		NH blacks (n = 2,484,446)		Hispanics (n = 3,516,805)		NH Asians (n = 850,907)	
	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)
Region of birth								
Midwest		0.260***		0.275***		0.167***		0.480***
		(0.248, 0.272)		(0.268, 0.282)		(0.157, 0.178)		(0.458, 0.503)
South		0.264***		0.179***		–0.071***		0.383***
		(0.250, 0.278)		(0.171, 0.187)		(–0.092, –0.051)		(0.370, 0.396)
West		0.135***		0.013***		–0.030***		0.297***
		(0.126, 0.144)		(0.004, 0.022)		(–0.042, –0.019)		(0.279, 0.315)
Year of birth								
1999		–0.036**		0.011**		–0.020		–0.169***
		(–0.066, –0.006)		(0.002, 0.021)		(–0.086, 0.046)		(–0.261, –0.077)
2000		–0.018		0.013		–0.052***		–0.098
		(–0.049, 0.013)		(–0.020, 0.046)		(–0.071, –0.034)		(–0.253, 0.056)
2001		–0.028		–0.027***		–0.025		–0.188**
		(–0.073, 0.017)		(–0.035, –0.019)		(–0.060, 0.011)		(–0.339, –0.037)
2002		–0.022		–0.000		–0.013		–0.169**
		(–0.085, 0.041)		(–0.013, 0.012)		(–0.075, 0.048)		(–0.318, –0.020)
Constant	–2.203***	–2.796***	–4.189***	–4.875***	–2.901***	–3.234***	–1.585***	–2.342***
	(–2.345, –2.061)	(–3.054, –2.538)	(–4.510, –3.868)	(–5.252, –4.499)	(–2.991, –2.812)	(–3.478, –2.990)	(–2.619, –0.551)	(–3.448, –1.237)

Note: Reference groups: US-born, <12 years maternal education, child female, 0 prior births, no 1st trimester care, Northeast residence, born 1998.
Source: 1998–2002 Birth Cohort Linked Birth-Infant Death Data (LBID), published by the National Center for Health Statistics.

Table A-2: Logistic regression models of neonatal mortality stratified by race/ethnicity

	NH whites (n = 10,667,982)		NH blacks (n = 2,484,446)		Hispanics (n = 3,516,805)		NH Asians (n = 850,907)	
	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)
Mother foreign-born	–0.372***	–0.325***	–0.545***	–0.546***	–0.295***	–0.336***	–0.314***	–0.251***
	(–0.554, –0.190)	(–0.490, –0.160)	(–0.844, –0.245)	(–0.752, –0.340)	(–0.417, –0.173)	(–0.446, –0.225)	(–0.487, –0.142)	(–0.377, –0.126)
Maternal age	–0.163***	–0.090***	0.018	0.117***	–0.149***	–0.090***	–0.247***	–0.196***
	(–0.175, –0.150)	(–0.116, –0.063)	(–0.005, 0.042)	(0.090, 0.144)	(–0.168, –0.130)	(–0.121, –0.060)	(–0.323, –0.171)	(–0.283, –0.109)
Maternal age^2	0.003***	0.002***	0.000	–0.001***	0.003***	0.002***	0.004***	0.004***
	(0.003, 0.003)	(0.001, 0.002)	(–0.000, 0.001)	(–0.002, –0.001)	(0.003, 0.003)	(0.002, 0.003)	(0.003, 0.006)	(0.002, 0.005)
Maternal education								
12 years	–0.205***	–0.164***	0.019	–0.039***	–0.117**	–0.152***	–0.011	0.020
	(–0.230, –0.181)	(–0.207, –0.122)	(–0.013, 0.051)	(–0.062, –0.016)	(–0.211, –0.024)	(–0.253, –0.052)	(–0.097, 0.075)	(–0.083, 0.124)
13–15 years	–0.457***	–0.396***	–0.108***	–0.204***	–0.188***	–0.253***	–0.095	–0.042
	(–0.488, –0.427)	(–0.445, –0.347)	(–0.171, –0.045)	(–0.240, –0.167)	(–0.270, –0.106)	(–0.354, –0.151)	(–0.255, 0.064)	(–0.189, 0.106)
16+ years	–0.732***	–0.650***	–0.276***	–0.455***	–0.593***	–0.686***	–0.616***	–0.519***
	(–0.788, –0.676)	(–0.710, –0.590)	(–0.385, –0.167)	(–0.520, –0.390)	(–0.732, –0.454)	(–0.817, –0.556)	(–0.887, –0.346)	(–0.799, –0.240)
Foreign-born* Education								
Foreign-born, 12 years	0.139	0.133	0.083	0.087	0.071	0.083	–0.009	–0.021
	(–0.058, 0.335)	(–0.045, 0.310)	(–0.274, 0.440)	(–0.262, 0.437)	(–0.039, 0.182)	(–0.033, 0.199)	(–0.118, 0.100)	(–0.152, 0.109)
Foreign-born, 13–15 years	0.135***	0.116***	0.173	0.193	0.073	0.105	–0.016	–0.040
	(0.080, 0.190)	(0.064, 0.167)	(–0.179, 0.526)	(–0.145, 0.531)	(–0.081, 0.228)	(–0.052, 0.261)	(–0.101, 0.069)	(–0.145, 0.064)
Foreign-born, 16+ years	0.347***	0.311***	0.327*	0.391***	0.248**	0.287***	0.382***	0.317**
	(0.205, 0.488)	(0.204, 0.417)	(–0.004, 0.657)	(0.097, 0.685)	(0.047, 0.450)	(0.089, 0.486)	(0.169, 0.594)	(0.034, 0.601)
Mother married		–0.261***		–0.108***		–0.085		–0.270***
		(–0.334, –0.187)		(–0.185, –0.030)		(–0.240, 0.070)		(–0.345, –0.195)
Child characteristics								
Child male		0.185***		0.198***		0.185***		0.076
		(0.177, 0.194)		(0.169, 0.228)		(0.130, 0.240)		(–0.044, 0.195)
1 prior birth		–0.290***		–0.503***		–0.339***		–0.185***
		(–0.334, –0.245)		(–0.519, –0.487)		(–0.433, –0.244)		(–0.271, –0.099)
2 prior births		–0.214***		–0.543***		–0.332***		–0.102***
		(–0.223, –0.205)		(–0.588, –0.497)		(–0.451, –0.213)		(–0.177, –0.027)
3 or more prior births		–0.004		–0.489***		–0.221***		0.060
		(–0.025, 0.017)		(–0.511, –0.468)		(–0.289, –0.153)		(–0.028, 0.147)
1st trimester prenatal care		–0.177***		–0.039***		–0.029		–0.013
		(–0.254, –0.099)		(–0.066, –0.012)		(–0.102, 0.044)		(–0.061, 0.034)

Table A-2: (Continued)

	NH whites (n = 10,667,982)		NH blacks (n = 2,484,446)		Hispanics (n = 3,516,805)		NH Asians (n = 850,907)	
	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)
Region of birth								
Midwest		0.243***		0.299***		0.185***		0.583***
		(0.229, 0.257)		(0.282, 0.317)		(0.170, 0.200)		(0.563, 0.603)
South		0.201***		0.203***		–0.139***		0.401***
		(0.187, 0.216)		(0.185, 0.221)		(–0.167, –0.110)		(0.386, 0.416)
West		0.072***		–0.071***		–0.041***		0.266***
		(0.061, 0.082)		(–0.090, –0.053)		(–0.058, –0.025)		(0.249, 0.283)
Year of birth								
1999		–0.030**		0.009		–0.006		–0.224***
		(–0.054, –0.005)		(–0.043, 0.062)		(–0.062, 0.049)		(–0.278, –0.170)
2000		–0.027**		0.007		–0.013		–0.124
		(–0.048, –0.006)		(–0.037, 0.051)		(–0.058, 0.033)		(–0.301, 0.052)
2001		–0.025**		–0.037***		–0.022		–0.239***
		(–0.047, –0.003)		(–0.058, –0.017)		(–0.065, 0.020)		(–0.365, –0.112)
2002		–0.030**		–0.020**		0.014		–0.190***
		(–0.055, –0.005)		(–0.039, –0.002)		(–0.053, 0.080)		(–0.260, –0.120)
Constant	–3.379***	–4.349***	–5.381***	–6.757***	–3.830***	–4.487***	–2.194***	–3.004***
	(–3.544, –3.213)	(–4.725, –3.973)	(–5.725, –5.037)	(–7.051, –6.463)	(–4.035, –3.624)	(–4.821, –4.153)	(–3.193, –1.194)	(–4.198, –1.810)

Note: Reference groups: US-born, <12 years maternal education, child female, 0 prior births, no 1st trimester care, Northeast residence, born 1998.
Source: 1998–2002 Birth Cohort Linked Birth-Infant Death Data (LBID), published by the National Center for Health Statistics.

Table A-3: Logistic regression models of postneonatal mortality stratified by race/ethnicity

	NH whites (n = 10,638,403)		NH blacks (n = 2,466,842)		Hispanics (n = 3,506,622)		NH Asians (n = 848,740)	
	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)
Mother foreign-born	–0.513*** (–0.816, –0.209)	–0.362** (–0.688, –0.036)	–0.852*** (–1.125, –0.580)	–0.627*** (–0.818, –0.436)	–0.490*** (–0.528, –0.453)	–0.388*** (–0.422, –0.354)	–0.725*** (–0.920, –0.529)	–0.539*** (–0.734, –0.344)
Maternal age	–0.205*** (–0.247, –0.163)	–0.240*** (–0.251, –0.230)	–0.066*** (–0.110, –0.022)	–0.149*** (–0.188, –0.109)	–0.191*** (–0.200, –0.182)	–0.220*** (–0.229, –0.211)	–0.201*** (–0.305, –0.097)	–0.172*** (–0.264, –0.079)
Maternal age^2	0.003*** (0.003 – 0.004)	0.004*** (0.003 – 0.004)	0.001*** (0.000 – 0.002)	0.002*** (0.002 – 0.003)	0.003*** (0.003 – 0.003)	0.004*** (0.003 – 0.004)	0.003*** (0.001 – 0.005)	0.003*** (0.001 – 0.004)
Maternal education								
12 years	–0.567*** (–0.651, –0.482)	–0.357*** (–0.431, –0.283)	–0.395*** (–0.450, –0.341)	–0.249*** (–0.290, –0.208)	–0.294*** (–0.407, –0.181)	–0.160*** (–0.274, –0.046)	–0.145** (–0.263, –0.027)	–0.052 (–0.160 – 0.057)
13–15 years	–0.913*** (–1.047, –0.779)	–0.588*** (–0.699, –0.478)	–0.665*** (–0.715, –0.614)	–0.400*** (–0.443, –0.357)	–0.563*** (–0.686, –0.440)	–0.343*** (–0.431, –0.254)	–0.724*** (–0.859, –0.590)	–0.519*** (–0.696, –0.343)
16+ years	–1.346*** (–1.441, –1.250)	–0.857*** (–0.931, –0.782)	–1.012*** (–1.161, –0.863)	–0.543*** (–0.643, –0.443)	–0.971*** (–1.105, –0.836)	–0.602*** (–0.665, –0.539)	–1.170*** (–1.360, –0.980)	–0.765*** (–1.022, –0.508)
Foreign-born* Education								
Foreign-born, 12 years	0.247 (–0.152 – 0.647)	0.202 (–0.217 – 0.621)	0.185*** (0.051 – 0.319)	0.157** (0.016 – 0.298)	0.094 (–0.019 – 0.207)	0.047 (–0.072 – 0.166)	0.175 (–0.102 – 0.451)	0.165 (–0.116 – 0.445)
Foreign-born, 13–15 years	0.384* (–0.034 – 0.802)	0.306 (–0.118 – 0.729)	0.385** (0.064 – 0.706)	0.318* (–0.008 – 0.644)	0.386*** (0.325 – 0.447)	0.317*** (0.252 – 0.381)	0.492*** (0.377 – 0.607)	0.429*** (0.261 – 0.598)
Foreign-born, 16+ years	0.400** (0.073 – 0.728)	0.276 (–0.060 – 0.613)	0.648*** (0.348 – 0.948)	0.455*** (0.167 – 0.743)	0.393*** (0.256 – 0.530)	0.274*** (0.144 – 0.404)	0.718*** (0.460 – 0.976)	0.565*** (0.316 – 0.814)
Mother married		–0.349*** (–0.407, –0.292)		–0.219*** (–0.242, –0.196)		–0.297*** (–0.387, –0.206)		–0.339*** (–0.446, –0.232)
Child characteristics								
Child male		0.272*** (0.226 – 0.318)		0.179*** (0.151 – 0.207)		0.169*** (0.080 – 0.258)		0.192*** (0.100 – 0.285)
0 prior births		0.359*** (0.326 – 0.393)		0.220*** (0.151 – 0.289)		0.275*** (0.190 – 0.360)		0.149*** (0.049 – 0.248)
1 prior birth		0.576*** (0.474 – 0.678)		0.422*** (0.363 – 0.481)		0.318*** (0.253 – 0.383)		0.314*** (0.077 – 0.552)
2 or more prior births		0.790*** (0.676 – 0.904)		0.670*** (0.620 – 0.719)		0.588*** (0.387 – 0.789)		0.548*** (0.359 – 0.738)
1st trimester prenatal care		–0.323*** (–0.339, –0.307)		–0.196*** (–0.245, –0.148)		–0.108*** (–0.162, –0.054)		–0.262*** (–0.337, –0.186)

Table A-3: (Continued)

	NH whites (n = 10,638,403)		NH blacks (n = 2,466,842)		Hispanics (n = 3,506,622)		NH Asians (n = 848,740)	
	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)	Model 1 Coeff (CI)	Model 2 Coeff (CI)
Region of birth								
Midwest		0.301***		0.223***		0.137***		0.266***
		(0.293 – 0.310)		(0.207 – 0.238)		(0.125 – 0.148)		(0.239 – 0.293)
South		0.375***		0.126***		0.046***		0.347***
		(0.363 – 0.386)		(0.113 – 0.138)		(0.030 – 0.061)		(0.326 – 0.368)
West		0.247***		0.150***		–0.007		0.345***
		(0.241 – 0.254)		(0.140 – 0.159)		(–0.019 – 0.005)		(0.308 – 0.381)
Year of birth								
1999		–0.046		0.016		–0.043		–0.069
		(–0.107 – 0.016)		(–0.068 – 0.100)		(–0.126 – 0.040)		(–0.227 – 0.089)
2000		–0.003		0.026		–0.121***		–0.048
		(–0.066 – 0.060)		(–0.008 – 0.060)		(–0.191, –0.052)		(–0.162 – 0.065)
2001		–0.032		–0.004		–0.028		–0.094
		(–0.128 – 0.063)		(–0.050 – 0.041)		(–0.106 – 0.050)		(–0.394 – 0.206)
2002		–0.009		0.040***		–0.060		–0.129
		(–0.142 – 0.123)		(0.014 – 0.065)		(–0.145 – 0.025)		(–0.427 – 0.169)
Constant	–2.493***	–2.312***	–4.157***	–3.369***	–3.285***	–2.972***	–2.657***	–3.279***
	(–2.976, –2.011)	(–2.533, –2.090)	(–4.665, –3.649)	(–3.872, –2.867)	(–3.400, –3.171)	(–3.064, –2.880)	(–4.007, –1.306)	(–4.486, –2.071)

Note: Reference groups: US-born, <12 years maternal education, child female, 0 prior births, no 1st trimester care, Northeast residence, born 1998.
Source: 1998–2002 Birth Cohort Linked Birth-Infant Death Data (LBID), published by the National Center for Health Statistics.