

INFLUENCE OF NATIVITY ON NEONATAL SURVIVAL OF BLACK TWINS IN THE UNITED STATES

Objective: To determine the association between maternal nativity and neonatal survival of twins among Black mothers.

Methods: We conducted a retrospective cohort study of twin live births to Black mothers in the United States from 1995 through 1998. We compared levels of overall, early, and late neonatal mortality between twins of US-born and those of foreign-born Black mothers by using hazard ratios generated from a Cox Proportional Hazards Regression model. We adjusted for dependence of observations within twin clusters by means of the Robust Sandwich Estimator.

Results: A total of 70,884 individual twin live births to US-born (64,035) and foreign-born (6,849) mothers were analyzed. Twins of US-born mothers had a 23% higher likelihood of dying within the neonatal period compared to those of foreign-born mothers (hazard ratio [HR]=1.23; 95% confidence interval [CI]=1.04–1.46). The disparity in neonatal demise occurred exclusively in the early neonatal period (HR=1.29; 95% CI, 1.06–1.50), with mortality indices comparable in the late neonatal period (HR=0.96; 95% CI, 0.68–1.35). Low and very low birth weight ($P<.0001$), preterm and very preterm ($P<.0001$), and small-for-gestational-age neonates ($P<.0001$) were more prevalent among twins of US-born mothers.

Conclusions: Compared to those of foreign-born, twins of US-born Black mothers experienced higher mortality in the neonatal period. The mortality disadvantage resulted mainly from lower gestational age at birth and the preponderance of small-for-gestational-age babies among US-born Black mothers. (*Ethn Dis.* 2005;15:276–282)

Key Words: Black, Mortality, Nativity, Twins

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INTRODUCTION

In the United States, Black women remain at higher risk for adverse pregnancy outcomes, including neonatal mortality, than their White counterparts. Although generally improved rates of neonatal survival with steadily decreasing rates of infant mortality have occurred over the years, a significant gap still persists between Blacks and Whites.^{1–4}

With growing public interest and efforts to reduce racial disparities in health outcomes and, specifically, the Black-White gap in birth outcomes, researchers have begun to explore other facets of the enigma. Maternal nativity has been identified as a major factor affecting pregnancy outcomes across races.^{4–6} This area of study is important, since the demography of the country continues to expand and diversify. During the last half of the 20th century, racial and ethnic diversity increasingly characterized the population of the United States, and as of 1998, immigrants made up approximately 9% of the US population.^{7,8} Consequently, the proportion of births to foreign-born women has risen.⁸

Investigations into the impact of nativity on pregnancy outcomes tend to suggest that foreign-born women generally have more favorable birth outcomes than their US-born counterparts.^{6,8,12} These studies have focused chiefly on singleton gestations, and the influence of nativity on birth outcomes among Black mothers with multiple pregnancies remains unexplored. The examination of multiples as a group

with a high-risk profile is important because they represent a distinct obstetric entity in terms of occurrence of adverse birth outcomes with etiologies that are likely to be distinct from those of singletons.

Recent vital statistics data have revealed a dramatic rise in the incidence of multiple gestations in the United States in recent years.¹³ Between 1980 and 1999, the overall multiple birth rate increased by 59%, with the majority of multiples being twins, and Black mothers have a higher twinning rate compared to Whites.^{14,15} This phenomenal upsurge in the incidence of multiple pregnancies is a public health concern because of the heightened risk to both mother and child. Multiples are more likely to be born earlier and smaller than singletons. They are also more susceptible to death within the first year of life, and if they do survive, are more likely to experience life-long disability.^{13,16,17} For these aforementioned reasons, it is important and timely both from a clinical and public health standpoint, to examine the relationship between nativity and birth outcomes among Black women with multiple gestation. In this study, we assessed this linkage among twin live births, with neonatal survival as the outcome of interest.

MATERIAL AND METHODS

The data source for this analysis was the “Matched Multiple Birth File” assembled by the National Center for Health Statistics (NCHS) for the period 1995 through 1998.¹⁸ The file contains

*Maternal nativity has been identified as a major factor affecting pregnancy outcomes across races.*⁴⁻⁶

individual records of live births and fetal deaths involving multiple deliveries. The completeness of records contained in the file is excellent (99%), and the procedures for quality control of the data are explained in detail elsewhere.¹⁹

Since correct analysis of multiple and correlated data such as that of twins is not possible without prior matching, the NCHS undertook the matching of records for deliveries involving multiple gestations for the years 1995–1998. The first stage of the matching involved building an algorithm consisting of variables from live birth and fetal death records that were considered the most uniquely identifying to the pregnancy. Live birth and fetal death records, which had identical values for these variables, were then identified. If the number of records with identical information equaled the reported plurality (eg, two records reported as twins) these records were considered members of the same multiple and assigned a unique set identification number. In those instances where the number of records with identical data exceeded the reported plurality of the records, visual review was conducted and matching done as appropriate. Approximately, 93% of all records were matched in this first stage. All other records were considered unmatched and included in subsequent matching procedures that involved use of additional variables and a composite of algorithmic combinations in addition to using manual identification methods. Perfect matching was finally achieved for 98.8% of the records, and the whole process has been adequately validated and found to be very accurate.¹⁸

We selected for twin live births to

Black mothers and compared birth outcomes among US-born to those of foreign-born Black mothers. We compared the following selected sociodemographic characteristics between the two subgroups: maternal age, marital status, parity, maternal education, adequacy of prenatal care utilization, and smoking during pregnancy. Adequacy of prenatal care was measured by using the R-GIN-DEX (revised graduated index) algorithm,²⁰ which determines whether prenatal care was adequate or not based on the trimester prenatal care began, the number of visits, and the gestational age of the infant at birth. Inadequate prenatal care refers to those women who had missing prenatal care information or who had prenatal care that was considered sub-optimal or mothers who had no prenatal care at all. This index of prenatal care is more accurate than other indices, especially in describing the level of prenatal care utilization among high-risk groups who may require more intense care (eg, multiple pregnancies).²¹ The accuracy of all these aforementioned variables on the birth certificate has been validated in previous studies and the information coded in these variables was accurately reported.^{22,23}

Neonatal morbidity status levels at birth included: low birth weight (<2500g) and very low birth weight (<1500g), preterm (<37 weeks) and very preterm (<33 weeks), and small-for-gestational-age (<10th percentile of birth weight for gestational age). Since the growth pattern of twins differs significantly from that of singletons, we applied growth curve references constructed specifically for twins.²⁴

For this study, the main birth outcome of interest was: neonatal mortality (death of the newborn within the first 28 days of life), which we further subdivided into early (from day one to day seven post-delivery) and late (from day eight to day 28 post-delivery) neonatal mortality.

Statistical Analysis

We compared the fetal growth patterns of twins born to US- and foreign-born Black mothers by computing means of gestational age-specific birth weights for each group and plotting these against their respective gestational ages. We then assessed overall differences between the two groups by means of the Student *t* test.

Adjusted and unadjusted hazard ratios were generated by using the partial likelihood method described by Cox after testing for the non-violation of the proportionality assumption.²⁵ We confirmed this by plotting the log-negative log of the Kaplan-Meier estimates of the survival function versus the log of time. The resulting curves were parallel. We also employed the Robust Sandwich Estimator (RSE) to adjust the estimates of the variance of the coefficients in order to account for the correlation among observations within twin sets.²⁶ We also determined the morbidity pathway for adjusted differences in neonatal mortality between the two nativity groups. The three main precursors of neonatal mortality, low birth weight, preterm, and small-for-gestational-age, were tested as candidate mediators that could have accounted for any observed differences in neonatal demise between the two ethnic sub-populations. All tests of hypothesis were two-tailed, with a type I error rate fixed at 5%.

This study was approved by the institutional review board at the University of Alabama at Birmingham.

RESULTS

A total of 446,570 deliveries involving multiple gestations were recorded in the United States between 1995 and 1998. Twins made up 94.2% (420,850) of the multiples. Black mothers accounted for 17.4% (73,352) of the total twin deliveries, out of which 70,884 (96.6%) were live births. Within this sample of live births analyzed in the

Table 1. Selected maternal sociodemographic characteristics among twins, United States, 1995–1998

Variable	US-born (N=64,035) (%)	Foreign-born (N=6,849)* (%)	P Value
Age			
<35	58,020 (90.6)	5,454 (79.6)	<.0001
≥35	6,015 (9.4)	1,395 (20.4)	
Marital status			
Married	19,974 (31.2)	3,933 (57.4)	<.0001
Single	44,061 (68.8)	2,916 (42.6)	
Education			
<High school	40,613 (63.4)	3,443 (50.3)	<.0001
≥High school	22,282 (34.8)	3,164 (46.2)	
Unspecified	1,140 (1.8)	242 (3.5)	
Parity			
Primipara	10,347 (16.1)	1,401 (20.5)	<.0001
Multipara	53,320 (83.3)	5,405 (78.9)	
Unspecified	368 (0.6)	43 (0.6)	
Prenatal care use			
Inadequate	27,056 (42.2)	3,025 (44.2)	.0023
Adequate	36,979 (57.8)	3,824 (55.8)	
Smoking during pregnancy			
Yes	6,345 (9.9)	110 (1.6)	<.0001
No	49,768 (77.7)	5,901 (86.2)	
Unspecified	7,922 (12.4)	838 (12.2)	

* Numbers refer to counts of individual twins (live births only).

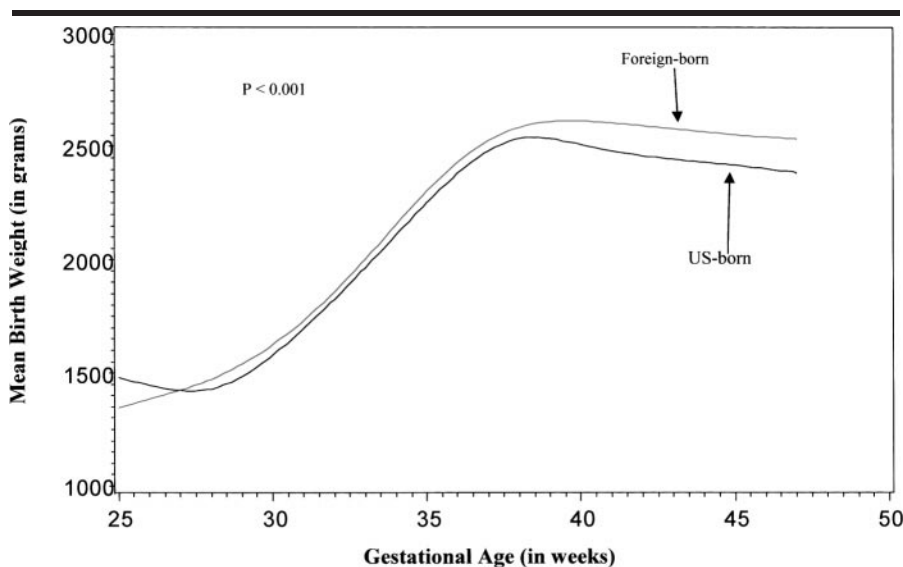


Fig 1. Fetal growth patterns of twins born to Black mothers by nativity status

study, twins delivered by foreign-born mothers represented 9.7% (6,849). The twinning rates among US-born and foreign-born mothers were 3.0% and 2.9% respectively.

As shown in Table 1, foreign-born Black women were more likely to be married, first-time mothers, have higher education, and were relatively older than their US-born counterparts. However, these women were less likely to smoke during pregnancy, and tended to have a lower level of adequate prenatal care than US-born Black women.

Figure 1 shows the mean birth weight by gestational age for twins based on maternal nativity status. From the late second trimester, we saw a consistent divergence in mean birth weight between the two groups of twins, with some widening of the disparity at term. The mean birth weight and gestational age of twins of foreign-born Black women was 2322.1 g (SE=8.6) and 35.4 weeks (SE=0.05) respectively, compared to 2176.1 g (SE=2.8) and 34.7 weeks (SE=0.02) for those of US-born mothers. Twins of foreign-born Black gravidas tended to be delivered 4.4 days later and weighed on average 146 g more than their counterparts of similar gestational age. These differences in mean birth weight and gestational age were significant ($P<.001$).

A total of 2,883 neonatal deaths occurred among the twin live births to Black mothers studied, resulting in a crude neonatal mortality rate of 40.7 per 1000.

Table 2 depicts crude neonatal, early neonatal, and late neonatal mortality by nativity status. Twins of US-born Black mothers experienced consistently higher mortality levels than those of foreign-born Black mothers. Adjusted hazard ratios for the association between neonatal mortality and nativity status are also presented in Table 2. After adjusting for maternal sociodemographic characteristics and prenatal care use, twins of US-born Black women had a 23% higher likelihood of dying within the first 28

Table 2. Crude mortality by maternal nativity status and adjusted hazard ratios for the association between maternal nativity and neonatal mortality among twins born to Black women, United States, 1995–1998 (foreign-born mothers are the referent category)

Outcome	Crude Rate per 1000		Adjusted HR*	95% CI†
	US-born	Foreign-born		
Neonatal mortality	41.5	32.9	1.23	1.04–1.46
Early neonatal mortality	36.5	27.3	1.29	1.06–1.50
Late neonatal mortality	6.0	5.5	0.96	0.68–1.35

* HR=hazard ratio. Adjusted estimates were generated after capturing the confounding effects of maternal age, marital status, level of education, parity, smoking, and prenatal care adequacy using the proportional hazard regression (PHREG) procedure.

† CI=confidence interval.

days of life, an estimate that is statistically significant. The disparity in neonatal demise occurred exclusively in the early neonatal period, with comparable mortality indices for the late neonatal period (Table 2).

We then proceeded to determine the

mechanism by which these differences in mortality could have been mediated. Low birth weight, preterm, and small-for-gestational-age are known precursors of neonatal death. In this analysis, these three conditions were found to be more prevalent among twins of US-born

mothers (Table 3). Consequently, we performed further analysis to assess the relative strength of these morbidities as intermediary factors in the pathway that leads to more neonatal demise among twins of US-born Black mothers. We loaded each of the three variables sequentially and separately into the model in the absence of the other two. We then noted the magnitude and direction of the change in the relative risk for neonatal death based on maternal nativity after the introduction of the morbidity variable into the model. In all cases, preterm and small-for-gestational-age (both of which are components of low birth weight) appeared to be equally important as independent contributors to the preponderance of neonatal mortality among US-born Blacks (Table 4).

DISCUSSION

In this study, we detected better neonatal survival among twins of foreign-born Black mothers, a finding that is in agreement with previous reports.^{1,9} Despite the fact that our analysis was conducted solely among twins, a birth population characterized by different risk profiles from those of singletons, we observed relative risk for neonatal mortality similar to that for US-born Black singletons about a decade ago.⁹ This finding implies that, despite improvements in neonatal care over time, with corresponding enhancement in the total neonatal survival in the United States, the benefits have not been sufficient to narrow the gap between US-born Blacks and their foreign-born counterparts. Several hypotheses have been advanced to explain this ethnic disparity, including healthy immigrant effect,^{1,9,27,28} stress and social support,^{29–36} higher socioeconomic status,^{35,36} environmental factors,^{37,38} and even genetic components.^{38,40} However, most of these hypotheses cannot adequately explain our findings.

According to the “healthy immi-

Table 3. Selected neonatal characteristics among twins of US-born and foreign-born Black mothers in the United States, 1995–1998

Variable	US-born (N=64,035)* (%)	Foreign-born (N=6,849)* (%)	P Value
Low birth weight†			
Yes	41,343 (64.6)	3,695 (54.0)	<.0001
No	22,348 (34.9)	3,123 (45.6)	
Missing	344 (0.5)	31 (0.5)	
Very low birth weight†			
Yes	10,591 (16.5)	890 (13.0)	<.0001
No	53,100 (82.9)	5,928 (86.6)	
Missing	344 (0.5)	31 (0.5)	
Preterm†			
Yes	37,103 (57.9)	3,566 (52.1)	<.0001
No	25,199 (39.4)	3,138 (45.8)	
Missing	1,733 (2.7)	145 (2.1)	
Very preterm†			
Yes	13,693 (21.4)	1,206 (17.6)	<.0001
No	48,609 (75.9)	5,498 (80.3)	
Missing	1,733 (2.7)	145 (2.1)	
SGA†			
Yes	3,672 (5.7)	328 (4.8)	.0009
No	58,630 (91.6)	6,376 (93.1)	
Missing	1,733 (2.7)	145 (2.1)	

* Numbers represent individual counts of twins (live births only).

† The sub class denoted missing represented infants who were excluded for the following reasons: for low and very low birth weight, only fetuses and infants with birth weight in the range of 227–8165 g were considered. For preterm and very preterm infants, the range taken into account was 17–50 weeks of gestation. Finally, for the classification of small-for-gestational-age, only infants with birth weight in the range of 227–6000 g, and with a gestational age range of 20–44 weeks, were considered.

Table 4. Morbidity pathway for the association between maternal nativity and neonatal demise among twins born to Black women, United States, 1995–1998 (foreign-born mothers are the referent category)

Outcome	Adjusted HR*	95% CI†
Low birth weight	1.02	0.86–1.22
Preterm	0.98	0.82–1.16
Small-for-gestational-age	1.06	0.90–1.26

* HR=hazard ratio. Adjusted estimates were generated by adjusting for the effects of maternal age, marital status, level of education, parity, smoking, and prenatal care adequacy in the Cox model.
† CI=confidence interval.

grant effect” hypothesis, the lower neonatal mortality among babies of foreign-born women is explained by the fact that immigrants are sturdier and have fewer reproductive losses than US-born women.²⁸ This assures them of better indices of pregnancy outcomes than their US-born counterparts. The same phenomenon has been proposed to explain the higher-than-expected level of low birth weight infants of US-born as compared to those of foreign-born Japanese women.¹¹ Using this argument, one would also expect White immigrants to have better reproductive as well as survival outcomes for their babies than their US-born correlatives. However, limited recent research has assessed differences in morbidity and mortality between infants of immigrants and those of US-born Whites by using US population-wide data.⁶ Further investigations focusing on specific countries of origin are needed to better explore the “healthy immigrant hypothesis.”

Socioeconomic differences between the two groups we studied are not likely a complete explanation. A growing body of literature indicates paradoxically advantageous birth outcomes to immigrant and US-born groups with adverse socioeconomic conditions.⁴¹ In this analysis, we controlled for the level of maternal education, a proxy for socioeconomic status, and still observed a significant difference in favor of twins born to foreign-born mothers.

As suggested by Pallotto et al,⁵ differences in cultural and psychosocial experiences before and during pregnancy

might have contributed to the relatively favorable birth outcomes among foreign-born Blacks. Prolonged exposure to institutional racism by US-born Black mothers has been postulated to be a contributory factor to the consistent finding of negative adult health and pregnancy outcome among African-American mothers.⁴² The African-American mother’s perception of her own residential environment and the experience and frequency of stressful events in her life were shown to correlate with very low birth weight.⁴³ This factor could also have been influential in the elevated risk for neonatal mortality among US-born Blacks in our study, especially because low birth weight was identified as an intermediary pathway that widened the risk differential in neonatal demise between the two ethnic groups. Unfortunately, our data source was devoid of relevant measures of psychosocial and stressful events during pregnancy.

The explanation of genetic differences due to racial admixture has been questioned⁴⁴ but rigorous data-based studies in this area have yet to emerge. Proponents of the “genetic factor hypothesis” posit that persisting differences in birth outcomes between Blacks and Whites could be because of underlying genetic variations. However, since disparities in birth outcomes are also documented between US-born and African-born mothers who share the same ancestral origin, genetic diversity is not likely the explanation. Still, other, yet-unproven hypotheses such as gene-en-

This finding implies that, despite improvements in neonatal care over time, . . . the benefits have not been sufficient to narrow the gap between US-born Blacks and their foreign-born counterparts.

vironment interactions might explain the birth outcome disadvantage among US-born Blacks. However, these interactions are complex and probably deep-rooted issues beyond the scope of this paper.

This work is limited by our failure to control for illicit drug use during pregnancy because this information is not available in the vital statistics record. Substance abuse (eg, marijuana, cocaine, and opiates) is known to be higher among US-born Black women compared to their foreign-born counterparts¹⁰; drug use is a negative behavior that could also explain our results. After controlling for the confounding effects of gestational age, weight gain during pregnancy, pre-pregnancy weight-for-height, marital status, prenatal care received, and the use of illicit drugs, infants of foreign-born Black women were still found to be heavier, longer, and larger in head circumference at birth than those of US-born Black mothers.¹⁰ Therefore, the lack of adjustment for illicit drug use in this study was not likely to have been the reason for our findings.

Another potential source of bias relates to the measurement of gestational age. Gestational age in completed weeks was computed from the interval between the first day of the last menstrual period (LMP) and the date of birth. Records missing the date of the LMP were imputed when there was a valid month

and year. Clinical estimate of gestation was used in the computation of gestational age in cases where the date of the LMP was not reported or where the LMP date was inconsistent with the birth weight.¹⁹ Approximately 4%-5% of the gestational ages during the period were based on clinical estimate of gestation. Despite this painstaking procedure, previous research has indicated that the reporting of gestational age on birth certificates may be subject to increasingly greater inaccuracies at gestational ages <37 weeks.⁴⁵

This study has the merit of being population based and is thus unlikely to have suffered from the effects of selection biases arising from the unique structure of the foreign-born population of a specific locale. While studies conducted in Boston and New York consisted predominantly of immigrants from the Caribbean,^{1,10} another study from Washington State selected mostly on women born in sub-Saharan Africa,¹² which limits the generalizability of study results. By using a national database, the full diversity of foreign-born Blacks was represented in the analysis. An additional strength of the paper is the use of an appropriate statistical technique to handle the occurrence of correlations within clusters. We applied the RSE to adjust for intra-cluster correlations in order to avoid shrinkage of computed standard errors, a bias that could lead to spurious associations. Hence, our results in this analysis are valid estimates.

We also noted a significant difference in mean birth weight across intra-uterine period between the two ethnic sub-groups. This finding is similar to the results among singletons and implies that the mechanisms responsible for the favorable advantage of foreign-born as compared to US-born Blacks are mediated in a similar fashion. This temporal variation may be explained by better pre-pregnancy health of foreign-born Black women.⁵ In support of this hypothesis is the observation that foreign-born Black women have superior pre-

pregnancy nutritional status compared to their US-born counterparts.¹⁰ Yet, another explanation may be the impact of previous intra-uterine as well as childhood social experiences of the mother on her offspring.⁴⁶⁻⁴⁸

In this study, both components of low birth weight (preterm and small-for-gestational-age) were found to mediate the differences in risk for neonatal mortality between twins of US-born and foreign-born mothers. This finding suggests that pre-conceptional factors related to the mother or conceptional dynamics associated with the pregnancy acting in isolation or concert play a role as determinants of subsequent neonatal differences in survival between the two ethnic groups.

The temporal variation observed in the disparity between the two groups regarding survival may have clinical relevance. The gap in risk did not span the entire neonatal period but was marked in the early neonatal period with no differences observed in the late neonatal period. This finding suggests that extra care may be needed mostly in the early neonatal period for twins born to US-born as compared to those of foreign-born women. Resources allocated to reduce the survival disadvantage among US-born Blacks may also be most cost-effective by dedicating a substantial portion of it to the first seven days of life.

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