

## **SELECTIVE MIGRATION AND INFANT MORTALITY AMONG PUERTO RICANS**

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## ABSTRACT

*Objective:* This study examines the implications of migration to the United States for infant mortality among Puerto Rican mothers born in Puerto Rico. The roles of selective migration and duration of U.S. residence are assessed. *Method:* Using survey data collected from mothers of infants sampled from computerized birth and infant death records of six U.S. vital statistics reporting areas and Puerto Rico, we estimate logistic regression models of infant mortality among the sampled infants. These models provide a baseline for comparison with fixed-effects models based on all births within each mother=s history. *Results:* Logistic regression models for focal infants show that the risk of infant mortality is lower for migrant women than for non-migrant women in Puerto Rico until the migrants have lived in the United States for a substantial period of time. Fixed effects models indicate that once unmeasured stable characteristics of the mother are controlled, early migrants do not differ from non-migrants with respect to the risk of infant death. Both sets of models demonstrate that as mothers= exposure to the U.S. mainland increases, the risk of infant mortality rises. *Conclusions:* Selective migration plays a role in the relatively low risk of infant mortality among recent Puerto Rican migrants to the United States. Migrants appear to be selected on qualities that are positively related to the health of their offspring, but those qualities are later lost with exposure to life in the United States.

Key words: infant mortality; migration; assimilation; Puerto Ricans

## INTRODUCTION

Over the last several decades, an extensive literature has documented better-than-expected health outcomes among Hispanics (1). Hispanics are disadvantaged socioeconomically compared to non-Hispanic whites, and have lower rates of health care utilization (2). Yet, on a number of health indicators, they exhibit comparable or better outcomes than non-Hispanic whites. This pattern of unexpectedly favorable health outcomes among Hispanics is often referred to as the "epidemiological paradox" or the "Hispanic paradox." The pattern is paradoxical because it is at odds with a large body of research that shows that socioeconomic disadvantage is a powerful predictor of poor health and mortality.<sup>i</sup>

The Hispanic paradox has been especially well documented for birth outcomes. In 2003, for example, Hispanic infants were less likely to be born with low birth weight and roughly equally likely to die in the first year of life compared to non-Hispanic white infants (3,4). Given their numeric dominance, the Mexican-origin population clearly drives the figures for Hispanics -- and Mexicans have been the focus of most group-specific research to date. In fact, comparisons of the birth outcomes of Mexican and white infants were central to the earliest explications of the paradox in the 1970s and 1980s (5-8). Later studies revealed a second puzzling pattern *within* the Mexican-origin population B that the health outcomes of infants of foreign-born mothers were better than those of infants of native-born mothers (9,10). This second set of findings has stimulated an ongoing line of research on the protective influence of Mexican culture and the loss of that influence with time spent in the United States (1).

Although much has been learned about the factors underlying the favorable birth outcomes of Hispanics, several issues have not been adequately addressed. First, because the literature is dominated by studies of the Mexican-origin population, less is known about the processes contributing to birth outcomes in other Hispanic subgroups. The mainland Puerto Rican population is a case in point. Puerto Ricans have *higher* rates of low birth weight and infant mortality than non-Hispanic whites and other Hispanic subgroups, including Mexicans (11). Thus, they are an exception to the Hispanic paradox in terms of their overall infant health status. At the same time, there is evidence that Puerto Rican mothers, like Mexican mothers, exhibit worsening birth outcomes as they spend more time in the United States (12,13). The complexities of the Puerto Rican pattern illustrate the perils of assuming that conclusions drawn from studies of Mexicans are applicable to all Hispanic groups.

The literature is also incomplete with respect to attention to competing explanations of Hispanics= positive birth outcomes. The influence of culture via social and health behaviors has been explored the most extensively. Although there are some inconsistent findings, studies generally show that Hispanic women who have not fully assimilated to U.S. culture have more nutritious diets and lower rates of substance use (i.e., smoking; drug use) during pregnancy than more fully assimilated Hispanics and non-Hispanic whites (1). These desirable health behaviors clearly play a role in the positive birth outcomes of Hispanics.

The potential effects of selective migration have received considerably less research attention. The favorable health outcomes of recent migrants may result partially or fully from the selective migration of women with characteristics that are

positively related to health. The neglect of this issue results partly from data limitations. The impact of selective migration cannot be determined without data that permit comparisons between non-migrants in the origin country and co-ethnic migrants in the receiving country. Such pooled origin-destination data are rare.

The present study extends the literature on the Hispanic paradox by examining the implications of migration to the United States for infant mortality among Puerto Ricans. Our analysis is based on data from the Puerto Rican Maternal and Infant Health Study (PRMIHS), which incorporated several design features that allow us to go beyond prior research on infant health outcomes among Hispanics. Specifically, the PRMIHS collected comparable data from Puerto Rican mothers of infants born in Puerto Rico and the mainland United States, included a large oversample of infant deaths, and obtained complete maternal birth and migration histories (14). We are therefore able to conduct analyses that examine two fundamental issues regarding variation in infant mortality *within* the Puerto Rican population. The first issue is whether and in what way duration of residence in the United States influences the risk of infant mortality. The second issue is whether the risk of infant mortality differs for the offspring of recent migrants to the U.S. mainland and the offspring of non-migrants in Puerto Rico. This comparison is central to understanding the potential role of selective migration in the pattern observed in the United States.

## **DATA AND METHODOLOGY**

### **Data**

The PRMIHS was designed to investigate maternal and infant health outcomes among Puerto Ricans in the United States and Puerto Rico. In-person interviews were

conducted with 2,763 mothers of infants sampled from the 1994 and 1995 computerized birth and infant death records of six U.S. vital statistics reporting areas (Connecticut, Florida, Massachusetts, New Jersey, New York City, and Pennsylvania) and the Commonwealth of Puerto Rico.<sup>ii</sup> Infants in the United States were eligible for the birth sample if the Hispanic ethnicity of the mother was designated as Puerto Rican on the birth certificate. Infants who died before their first birthday were eligible to be included in the U.S. death sample if they were identified as Puerto Rican on the death certificate or if their mother was classified as Puerto Rican on the birth certificate.<sup>iii</sup> About two-thirds of the interviews (1,946) were with mothers of infants sampled from birth certificates and one-third of the interviews (817) were with mothers of infants drawn from death certificates for infant deaths. Response rates for the birth and death samples, respectively, were 79 percent and 74 percent (14). The weighted birth sample is representative of 1994-1995 births to Puerto Rican women residing in the study areas. The oversample of deaths includes all infants in the study areas who died before their first birthday during the designated time frame. All study interviewers were bilingual, and the questionnaire was available in both Spanish and English.

Parts of our analysis focus exclusively on outcomes of the focal infants, the specific infants sampled for the PRMIHS (n = 2,763). We restrict our analytic sample to infants of mothers who were born in Puerto Rico because the key comparison for understanding the role of selective migration is that between island-born mothers who remain in Puerto Rico and island-born mothers who migrate to the United States. After we eliminate 1,190 infants whose mothers were born in the United States (n = 1,149) or elsewhere (n = 41), the analytic sample consists of 1,573 focal infants.

As we discuss below, we also take advantage of the fact that the PRMIHS collected a complete birth history from each mother, including information on the circumstances and outcomes of each live birth. From the birth history, we constructed an additional dataset that consists of all infants born to each mother in the analytic sample. We use this data set to estimate fixed effects models that parallel the models estimated for the focal infants. The fixed effects models allow us to control for unmeasured characteristics of mothers that may influence both migration and the risk of experiencing an infant death (15). Because fixed effects models require data on two or more births per woman, our sample for these models consists of all infants born to mothers who had at least two live births ( $n = 3,484$ ).

### **Variables**

The dependent variable is whether or not an infant died before his or her first birthday (1=yes; 0=no). The key predictors are maternal place of residence at the time of the infant=s birth (1=U.S. mainland; 0=Puerto Rico) and the mother=s cumulative years of residence on the U.S. mainland as of the infant=s date of birth. The years of U.S. residence variable was constructed from the mother=s report of the number of years she had lived in the United States before her 10<sup>th</sup> birthday and her complete migration history starting at age 10. Using the migration history, episodes of U.S. residence from age 10 to the birth of the child were cumulated to measure the total number of months of U.S. residence after the mother=s 10<sup>th</sup> birthday. After conversion to years, exposure from the 10<sup>th</sup> birthday forward was added to exposure before age 10, resulting in a measure of the total number of years in the United States. The duration of residence variable represents an advance over prior research because it takes into

account the *total* exposure women have across multiple episodes of migration. This is especially important for Puerto Ricans because of the frequency of circular and repeat migration. The exposure variable is meaningful for mothers residing in both the United States and Puerto Rico because many mothers in Puerto Rico have prior experience living in the United States.

Although more detailed information is available on focal infants than on the other births in the mothers' histories, our goal is to make the models for focal children comparable to the fixed effects models, which are based on the history data. Thus we restrict the predictors to those that are available for all births. All independent variables are measured as of the birth date of the specific infant in the mother's history.

The demographic risk factors included in the analysis are birth order, maternal age, and maternal union status. Our measure of maternal age contrasts mothers who were less than age 20 with mothers who were 20 or older when the infant was born.<sup>iv</sup> Maternal union status contrasts mothers who were single (not living with a partner) separately with those who were cohabiting and those who were married at the time of the infant's birth. To measure socioeconomic status, we use the mother's education, measured as the highest degree obtained by the time of the infant's birth. Education is coded as: 0=no degree; 1=GED; 2=regular high school diploma; 3=associate's degree; 4=bachelor's degree; 5=master's degree; 6=doctorate. Although this variable is ordinal, it is treated as interval in the analysis on the basis of the patterns found in initial analyses.<sup>v</sup>

Our models of infant mortality also consider the health status of the infant at birth. Because infant birth weight is a proximate biological determinant of infant death,



most of our models of infant mortality do not include birth weight as a predictor. However, we address the role of birth weight in a final model to shed light on its importance as a mechanism through which other predictors influence infant mortality. Birth weight is a continuous variable that is measured in grams.<sup>vi</sup>

## **Methods**

Palloni and Arias argue that there are three basic explanations for the Hispanic health and mortality advantage: (1) data artifacts, (2) a cultural effect, and (3) migration effects (16).<sup>vii</sup> The primary data artifact that might affect a study, such as the PRMIHS, that identifies deaths from death certificates is underreporting of Hispanic origin on the U.S. death certificate (17). To eliminate this problem the PRMIHS identified infant deaths using two sources. First, all infant deaths in which the decedent was listed as Puerto Rican on the death certificate were included. Second, using the linked birth-infant death files available from each U.S. vital statistics reporting area, all infant deaths to mothers identified as Puerto Rican on the birth certificate were included. This latter procedure resulted in inclusion of a substantial number of death cases that would not have been included if the study relied on the death certificates alone.

The cultural hypothesis is sometimes evaluated by comparing the health practices (e.g., diet, exercise, substance use), social support, and values regarding motherhood among Hispanics to those of *other* groups, such as non-Hispanic whites. This approach cannot be followed in the present study, for three reasons. First, the PRMIHS focuses exclusively on Puerto Ricans and does not include non-Hispanic whites. Second, our interest lies in variation in the risk of infant mortality *within* the Puerto Rican population. Third, measures of the abovementioned factors that are specific to each

birth in the mothers= histories are not available. Another approach to examining the cultural hypothesis focuses on variation in the infant mortality risks of foreign-born mothers by duration of residence. Rising risks with additional U.S. exposure suggest that the salutary practices of the foreign born are abandoned and the less healthy lifestyles of the native born are adopted as migrants spend more time in the United States. Ideally, one would test this explanation further by directly examining differences in health practices, social support, and values by duration of residence, but in the absence of information on such variables, support for the cultural hypothesis is garnered from a pattern of rising risks of infant mortality with maternal exposure to life in the United States.

The most important hypothesis regarding the migration process itself is sometimes called the *healthy migrant effect*.<sup>6</sup> This hypothesis is that migrants to the United States have favorable health outcomes because migrants are positively selected on physical and mental health, or on other characteristics that are related to health. Evidence of such positive selection would be found in better health outcomes among recent migrants to the United States than among non-migrants in the origin country. Although ideally, researchers could control for the characteristics on which migrants are selected, thus explaining the healthy migrant effect, there are typically many unmeasured characteristics that might be related to both migration and health. Some purchase on the role of unmeasured maternal characteristics in explaining differences in infant mortality between migrants and nonmigrants can be obtained by using fixed effects models that estimate *within-mother* differences in infant mortality. Because fixed effects models focus on differences in mortality across the births in a mother=s

history, all stable characteristics of mothers are controlled. If such unmeasured characteristics are related to both migration and infant mortality, then the role of migration should be reduced or eliminated in fixed effects models, compared to models that estimate *between-mother* differences in infant mortality risks.

To address these hypotheses, we first estimate logistic regression models based on all focal children in the PRMIHS. These models provide a baseline for comparison with fixed effects models of *within-mother* differences across births. Examination of coefficients from the fixed effects models allows us to assess the role of migration in infant mortality net of all stable unmeasured characteristics of mothers that might be related to both the propensity to migrate and to infant death.

To control for stable unmeasured characteristics of individuals, we utilize a hybrid model outlined in Allison (17). We decompose the time-varying predictors into two parts, which represent within-person and between-person variation. The within-person component is based on difference scores created by subtracting person-specific means from each time-varying predictor. The between person component is based on person-specific means, or the means of each mother's values across all of her births. Our logistic regression models include both the mean-centered difference scores and the person-specific means as predictors of a binary variable measuring whether or not the infant died.<sup>viii</sup> The within-mother coefficients can be interpreted as the relationship between a given predictor and infant mortality, controlling for all stable unmeasured characteristics of the mother. The fixed effects assumption is evaluated by testing for the difference between the coefficients for the centered variables and the mean variables.

All models are estimated with SUDAAN, which adjusts the standard errors for the complex sample design employed in the PRMIHS. Standard errors from the fixed effects models are also adjusted for the clustering of observations within mothers. All models are based on weighted data, using the final birth and death sample weights. The weights were adjusted to retain the original sample size. Cases with missing data are *not* excluded from the analysis. Instead, Bayesian procedures for the multiple imputation of missing data are employed (Schafer 1997, 1998). Five imputations were made to generate plausible values for missing data, and the five imputed data sets were then analyzed with standard complete-data methods. The results were combined to yield estimates, standard errors, and *p*-values that incorporate uncertainty about missing data.

## **RESULTS**

Table 1 presents descriptive statistics for the variables included in the analysis, by the infant=s mortality status. The first two columns of the table present the means for focal infants and the second two columns provide means for all infants of mothers who had at least two births. As noted, all infants included in the analytic sample had mothers who were born in Puerto Rico. Some of the mothers resided in Puerto Rico at the time of the infant=s birth, while other mothers had migrated to the mainland United States. In addition, mothers who were born in Puerto Rico and lived there when the infant was born had varying experiences with prior U.S. residence; some had never lived in the United States, while others had migrated and later returned to Puerto Rico.

Focusing first on focal infants, about 16% of those who survived and 13% of those who died were born in the United States. The infants= mothers had lived in the United

States for an average of 4 years (4.07 for mothers of surviving infants and 4.65 for mothers of deceased infants), although mothers who lived in the United States when the infant was born had considerably more U.S. experience (a mean of 11.81 years for mothers of surviving infants and 12.68 years for mothers of infants who died, not shown). Compared to mothers of surviving infants, mothers of deceased infants were younger, were more likely to be cohabiting, and had lower levels of education. In addition, deceased infants had lower birth weight than surviving infants (a mean of 1836 grams for the former group and 3190 grams for the latter). Similar differences are evident in the sample of all children with siblings for years of U.S. residence, cohabitation, and birth weight.

Table 2 presents the multivariate analysis, which consists of a series of logistic regression models of infant mortality. Model 1 includes only place of residence when the infant was born (United States versus Puerto Rico) and a measure of the mother's lifetime exposure to residence on the U.S. mainland. Model 2 controls for birth order, maternal age, union status, and education. Model 3 adds the infant's birth weight to the predictors included in Model 2.

Models 1 and 2 for focal infants show that the risk of infant mortality is significantly lower for infants born in the United States than for those born in Puerto Rico, controlling for the mother's lifetime years of residence on the U.S. mainland. However, the longer the mother has lived in the United States, the higher the risk of infant mortality. Taken together, the coefficients for U.S. residence and years of U.S. residence indicate that the risk of infant mortality is lower for migrants than for women living in Puerto Rico until the migrants have lived in the United States for a substantial

period of time. For example, the coefficients for Model 2 imply that migrant mothers have lower risks of infant mortality than non-migrant mothers in Puerto Rico (with no U.S. experience) until the former have lived in the United States for about 18 years [ $-.36 + (.02*18)$ ]. Subsequently, migrants' risks of infant mortality exceed those of non-migrant mothers in Puerto Rico.

The similarity of the results for place of residence and duration of U.S. residence across Models 1 and 2 show that birth order and the mother's age, union status, and education do not account for the observed relationships. However, once the infant's birth weight is added in Model 3, neither the mother's place of residence nor the mother's U.S. exposure is significantly related to infant mortality. Thus, the effects of the migration-related variables on infant mortality appear to be completely mediated by the infant's birth weight.<sup>ix</sup>

The three right-hand columns of the table present results from the hybrid fixed effects models.<sup>x</sup> The within-mother coefficients are of primary interest. As noted earlier, they represent the effect of a given variable on the risk of infant death, controlling for stable unmeasured characteristics of mothers. If such unmeasured attributes are fully or partially responsible for the relationships between the migration variables and infant mortality observed among focal children, then we would expect the within-mother coefficients for those variables to be attenuated or reduced to non-significance in the fixed-effects models.

In Models 1 and 2, the within-mother coefficients for U.S. residence diverge from those in the models for focal children: the within-mother coefficients are positive and non-significant. The coefficients for years of U.S. residence remain significant and are

considerably larger in magnitude than in the models based on focal children. Taken together, these findings indicate that the risk of infant mortality for a recent migrant to the U.S. mainland is roughly similar to that of a non-migrant in Puerto Rico, once other differences between migrants and non-migrants are controlled. However, as the migrant=s exposure to the U.S. mainland increases, the risk of infant mortality rises rapidly.

This pattern suggests that the lower risks of infant mortality observed among Puerto Rican migrants in their early years of U.S. residence are due to selection on unmeasured characteristics that contribute to favorable birth outcomes. Once unmeasured stable characteristics of the mother are controlled, early migrants do not differ from non-migrants with respect to the risk of infant death. At the same time, there is evidence that the longer Puerto Rican mothers live in the United States, the higher the risk of experiencing an infant death. This is consistent with explanations that emphasize worsening health habits and the erosion of social support with duration of residence in the United States.

## **CONCLUSIONS**

The role of selective migration in maternal and infant health among Hispanics is understudied, despite its potential importance as an explanation of the favorable birth outcomes of recent migrants to the United States. The primary reason for the lack of attention to selective migration is the scarcity of data appropriate for examining the issue. Understanding the complexities of the link between maternal migration and birth outcomes requires data that allow for comparisons between migrants to the U.S. mainland and non-migrants in the origin country. Further, information on duration of

residence  $\geq$  preferably across the full life course  $\geq$  is important for distinguishing recent migrants from long-term migrants and those with extensive U.S. experience from an earlier episode of migration.

The PRMIHS was designed to address the links between migration, assimilation, and birth outcomes among Puerto Ricans. Because it is based on representative samples of births to Puerto Rican mothers in the United States and in Puerto Rico -- and includes detailed history data on mothers' migration experiences and births  $\geq$  the PRMIHS provides a rare opportunity to compare infant mortality among non-migrants in Puerto Rico and recent migrants to the U.S. mainland, and to examine how infant mortality varies with the mother's mainland experience.

Our analysis of focal infants shows that the risk of infant mortality is substantially lower among migrants with relatively few years of residence on the mainland than it is among women who remain in Puerto Rico. This is the case both before and after basic controls are included in the model. This pattern strongly suggests that migrant women are positively selected on unmeasured characteristics (e.g., physical health, mental health, or motivation to succeed) that are related to the survival chances of their infants. Our fixed effects models based on all infants in each mother's history provide further support for an emphasis on selective migration. By comparing birth outcomes *within* a specific mother's history, fixed effects models control for all stable unmeasured characteristics of mothers that may be related to both migration and infant death. Results from the fixed effects models indicate that, once such characteristics are controlled, recent migrants no longer differ from non-migrant women in Puerto Rico with respect to the risk of infant mortality. Thus, it is something about the mothers who



migrate rather than the experience of migration itself that accounts for the favorable outcomes of recent migrants.

At the same time, even positively selected mothers can experience deteriorating health habits and outcomes with time in the United States. Both the models for focal infants and the fixed-effects models indicate that mothers who have lived in the United States the longest have the highest risk of infant mortality. The relationship between duration of U.S. residence and infant mortality holds for both mothers who were living in the United States at the time they gave birth and mothers who were living in Puerto Rico (but formerly lived in the United States). Thus, our analysis provides evidence that both selective migration and negative assimilation are operating. Migrants appear to be selected on qualities that are positively related to the health of their offspring, but those qualities are later lost with exposure to life in the United States. Although we cannot specify those characteristics in the present analysis due to limitations of the PRMIHS,<sup>xi</sup> identification of the protective attributes and behaviors of Puerto Rican migrants is an important next step for future research on Puerto Rican infant health.

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**Table 1. Means for Predictors by Mortality Status, Infants Born in the US and Puerto Rico,**

**Mothers Born in Puerto Rico**

	All Focal Children		All Children with Siblings	
	Survivors	Deaths	Survivors	Deaths
US resident	.16	.13	.14	.14
Years of US residence	4.07	4.65+	3.76	4.93***
Birth order	2.18	2.25	2.23	2.53***
Age less than 20	.20	.25*	.29	.24*
Cohabiting	.34	.42**	.38	.44**
Married	.51	.44**	.46	.41+
Education at birth	1.61	1.46*	1.29	1.41+
Birth weight (grams)	3189.61	1835.99***	3122.28	1862.58***
N of cases	1,006	567	2,924	560

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+ p< .10; \* p<.05; \*\* p<.01; \*\*\* p<.001(two-tailed t-test)

**Table 2. Logistic Regression Models of Infant Mortality: Infants Born in the US and Puerto Rico, Mothers Born in Puerto Rico**

	All Focal Children			All Children with Siblings (Hybrid Fixed Effects Models)		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
	<u>Within-Mother Coefficients</u>					
US resident	-.34* (.15)	-.36* (.16)	-.22 (.19)	.17 (.24)	.20 (.29)	.19 (.31)
Years of US residence	.01** (.01)	.02** (.01)	.01 (.01)	.13*** (.02)	.06* (.02)	.02 (.04)
Birth order		.05 (.04)	.04 (.04)		.52*** (.06)	.47*** (.08)
Age less than 20		.32* (.15)	.00 (.16)		.36+ (.19)	.20 (.25)
Cohabiting		.25 (.16)	.57** (.19)		.50** (.18)	.72** (.23)
Married		-.02 (.16)	.35* (.18)		.33 (.26)	.24 (.35)
Education at birth		.00 (.04)	.05 (.05)		.13 (.18)	.10 (.21)
Birth weight (kilograms)			-1.62*** (.05)			-1.98*** (.12)
	<u>Between-Mother Coefficients</u>					
US resident				-.24 (.18)	-.23 (.17)	-.06 (.18)
Years of US residence				.01 (.01)	.01+ (.01)	.00 (.01)
Birth order					-.47*** (.09)..	-.58*** (.10)
Age less than 20					.09 (.19)	-.14 (.19)
Cohabiting					.09 (.21)	-.09 (.23)
Married					-.41* (.20)	-.40* (.20)
Education at birth					.07 (.06)	.02 (.06)
Birth weight (kilograms)						-1.36*** (.06)
N of cases	1,573	1,573	1,573	3,484	3,484	3,484

+ p<.10; \* p<.05; \*\* p<.01; \*\*\* p<.001

## ENDNOTES

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<sup>i</sup> Hispanics= health status is not uniformly positive. For example, Hispanics have high rates of obesity, which contribute to diabetes, hypertension, and cardiovascular disease. They also have worse oral health and higher blood lead levels than non-Hispanic whites (2).

<sup>ii</sup> The PRMIHS included the states with the greatest number of births to Puerto Rican women each year. In 1994 and 1995, 72 percent of all births to Puerto Rican women in the United States occurred in these six states. The state of New York is divided into two separate vital statistics reporting areas, New York City and the remainder of the state. The City of New York granted permission to conduct the survey, but the State of New York did not. New York cases are therefore restricted to births and deaths occurring in New York City.

<sup>iii</sup> Information on ethnicity is not included on the birth and death certificates in Puerto Rico because an extremely high percentage of island residents are of Puerto Rican descent. To avoid inclusion of non-Puerto Rican infants in the study, a question on whether the focal infant was of Puerto Rican descent was included to screen for eligibility. Mothers who answered that their infant was not of Puerto Rican descent were excluded from the study. This screening question was used in both Puerto Rico and in the U.S. states.

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iv Although prior studies have found that both younger mothers (less than age 20) and older mothers (greater than age 35) have relatively high risks of poor birth outcomes (compared to women 20-34), our preliminary analyses did not show differences between the oldest two groups.

v The mother=s completed education in years is available in the PRMIHS. However, it is only measured as of the focal infant=s birth. We use the mother=s highest degree because it can be measured on a time-varying basis.

vi The coefficients for birth weight in the logistic regression models are expressed in terms of kilograms to allow for greater detail in reporting.

vii Palloni and Arias focus on adult mortality, but the central arguments are equally applicable to infant mortality.

viii In the hybrid model, the dependent variable is not calculated as a centered variable.

ix In earlier models, we included an interaction term representing the interaction between maternal place of residence and years of U.S. residence. The interaction term was not significant in any models.



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<sup>x</sup> Tests of the fixed effects model versus the random effects model indicate that the random effects model must be rejected in favor of the fixed effects model in Models 1, 2 and 3.

<sup>xi</sup> Very limited information was collected on the mother=s circumstances and health habits during the various pregnancies leading to births in her history.