



## Original article

## The “Latina Epidemiologic Paradox”: Contrasting Patterns of Adverse Birth Outcomes in U.S.-Born and Foreign-Born Latinas

Marie E.S. Flores, MD, PhD, MPH<sup>a,\*</sup>, Sara E. Simonsen, PhD, MSPH, CNM<sup>b</sup>, Tracy A. Manuck, MD<sup>c</sup>, Jane M. Dyer, CNM, FNP, MBA, PhD, FACNM<sup>d</sup>, David K. Turok, MD, MPH<sup>c</sup>

<sup>a</sup>School of Medicine, University of Utah, Salt Lake City, Utah

<sup>b</sup>Division of Public Health, Department of Family and Preventive Medicine, University of Utah School of Medicine, Salt Lake City, Utah

<sup>c</sup>Department of Obstetrics and Gynecology, University of Utah, Salt Lake City, Utah

<sup>d</sup>College Of Nursing, University Of Utah, Salt Lake City, Utah

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### ABSTRACT

**Background:** The “Latina epidemiologic paradox” postulates that despite socioeconomic disadvantages, Latina mothers have a lower risk for delivering low birth weight (LBW) babies than non-Latina Whites. However, these patterns may be changing over time and may differ depending on the mother’s birthplace and legal status in the United States. This study investigates differences in risk for three birth outcomes among Whites, U.S.-born Latinas, and foreign-born Latinas.

**Methods:** We undertook a cross-sectional study of rates of LBW, preterm, and small-for-gestational-age (SGA) births among 196,617 women delivering live, singleton births in Utah from 2004 to 2007. Each group was compared using logistic regression.

**Results:** U.S.-born Latinas had a similar or greater risk for all three outcomes when compared with Whites. Foreign-born Latinas had lower risk for preterm birth (odds ratio [OR], 0.85; 95% confidence interval [CI], 0.80–0.90) compared with Whites, but not for LBW and SGA; foreign-born Latinas had a lower risk for LBW (OR, 0.82; 95% CI, 0.74–0.92), preterm birth (OR, 0.81; 95% CI, 0.74–0.89), and SGA (OR, 0.91; 95% CI, 0.83–0.99) compared with U.S.-born Latinas. Among foreign-born Latinas only, there was no difference in risk between documented (i.e., those who had a legal social security number) and undocumented women for LBW, preterm birth, or SGA.

**Conclusions:** These data support the existence of a variation of the “Latina paradox” among Latinas according to birthplace, where U.S.-born Latinas do not experience better birth outcomes than Whites, but foreign-born Latinas experience better birth outcomes for several endpoints compared with U.S.-born Latinas. Prevention efforts may prove more effective by considering the different composition of risk factors among foreign- and U.S.-born Latina populations.

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### Introduction and Background

Although Latinas living in the United States are on average an undereducated and medically underserved minority group, their infants have been shown to be less likely to experience low birth weight (LBW) and infant mortality, compared with infants of non-Latina White women (hereafter referred to as “Whites”; Collins & Shay, 1994; Fuentes-Afflick & Lurie, 1997; Hayes-Bautista, 2004; Williams, Binkin, & Clingman, 1986). This phenomenon has been labeled the “Latina epidemiologic paradox” because the observed pattern of LBW for Latinas is at

odds with what would be expected given their “adverse” socioeconomic profile (Acevedo-Garcia, Soobader, & Berkman, 2007; Fuentes-Afflick & Lurie, 1997; Hayes-Bautista, 2004). A similar paradox has also been observed within the ethnic group; foreign-born Latinas, particularly those of Mexican origin, have been reported to give birth to fewer LBW infants than their U.S.-born counterparts, despite a higher prevalence of risk factors, such as poverty and less education (Acevedo-Garcia, Soobader, & Berkman, 2005; Fuentes-Afflick, Hessol, & Perez-Stable, 1998; Madan et al., 2006).

However, previous publications addressing the Latina paradox of LBW have not consistently distinguished U.S.-born Latinas from foreign-born Latinas in the analyses, have not considered legal status among foreign-born Latinas (i.e., undocumented immigrants), and have not widely studied other birth outcomes

\* Correspondence to: Marie E.S. Flores, MD, PhD, MPH, 123 Medical Plaza, Salt Lake City, UT 84112, USA. Phone: 801-585-4602; fax: 801-585-2594.

E-mail address: marie.flores@hsc.utah.edu (M.E.S. Flores).

known to be predictors of infant morbidity and mortality, such as preterm birth or small-for-gestational-age (SGA) infants, in addition to LBW (Brown, Chireau, Jallah, & Howard, 2007; Buekens, Notzon, Kotelchuck, & Wilcox, 2000; Cervantes, Keith, & Wyshak, 1999; Collins & Shay, 1994; Fuentes-Afflick & Lurie, 1997). Furthermore, prior studies have primarily examined either national data or data from states with very large Latino populations (e.g., California). States with smaller yet rapidly growing Latino populations that are considered “new immigrant destinations” (Korinek & Smith, 2011) have not been widely examined for Latino health outcomes or the Latina epidemiologic paradox. Utah’s Latino population has grown more than 20% over a 9-year period, comprising over 11% of the current population (United States Census Bureau, 2000, 2005) making it an ideal state in which to study the Latina paradox in order to confirm or refute patterns reported from other areas. Moreover, Utah is one of a few of states that does annual data audits for 5% of births at each hospital to check for errors and missing information on birth certificates as well as to train abstractors for quality control purposes; therefore, this improves the quality of Utah birth data for research purposes.

Thus, the aim of this study was to examine the risk for LBW, preterm birth, and SGA among U.S.-born Latinas, foreign-born Latinas (including a subanalysis of undocumented immigrants), and White women with singleton, live-born infants in Utah. If a paradox exists in a state with a large Caucasian demographic, this knowledge will aid clinicians and public health practitioners in better understanding and potentially modifying specific pregnancy-related risk factors that may vary among Latina subgroups living in the United States.

## Methods

### *Data Sources and Study Population*

All live birth records were queried from the State of Utah Department of Health from January 1, 2004, to December 31, 2007. We identified Latina and White mothers who gave birth to singleton, live-born infants at 20 weeks’ or more gestation during this timeframe. All women who answered “yes” to the “Hispanic origin” field (including Mexican, Chicano, Cuban, Puerto Rican, Central/South American, or other Hispanic of any race) were classified as “Latina.” We classified a woman as “White” if “White” was listed as her race and she answered “no” to the “Hispanic origin” field. Mothers whose birthplace was reported as a state within the 50 United States or District of Columbia were considered U.S.-born; all others were considered foreign-born. Ancestry of U.S.-born Latinas was taken from “Hispanic origin” text field (if filled out).

Multiple gestations ( $n = 6,191$ ), births to mothers with missing data in the “Hispanic origin” field of the birth certificate ( $n = 1,043$ ), and those who were not Latina or White ( $n = 10,998$ ) were excluded. We further excluded births with missing gestational age ( $n = 1$ ), gestational ages less than 20 weeks ( $n = 40$ ), missing birth weights ( $n = 23$ ), birth weights less than 200 g or greater than 5,499 g ( $n = 28$ ), and those with missing maternal birth place ( $n = 326$ ).

### *Variable Selection and Outcome Assessment*

Demographic, intrapartum, and delivery data were collected from the birth certificate, and compared between the three groups. The three primary outcome variables were LBW (<2,500 g), preterm birth (<37.0 weeks completed gestation by the best clinical

estimation of gestational age, that is, the gestational age reported by the birth attendant based on the woman’s last menstrual period (LMP), ultrasound dating, and/or other clinical judgment), and SGA (determined by <10th percentile of birth weight for gestational age and gender, based on the best clinical estimate of gestational age as reported by the birth attendant and a national reference for fetal growth; Alexander, Himes, Kaufman, Mor, & Kogan, 1996).

Several maternal risk factors were also identified on the birth certificate as exposure variables for consideration in the analysis. Women were considered to have a “maternal medical risk factor” if they had at least one of the following documented on the birth certificate: cardiac disease, acute or chronic lung disease, hemoglobinopathy, chronic hypertension, renal disease, or pre-existing diabetes types 1 or 2. “Pregnancy complications” were defined as the presence of at least one of the following: anemia, genital herpes, polyhydramnios or oligohydramnios, pregnancy-induced hypertension (including preeclampsia), eclampsia, uterine bleeding, Rh sensitization, or gestational diabetes. To classify parity, a woman was considered primiparous if she had no previous deliveries before the recorded pregnancy, and women with one or more prior deliveries were considered multiparous.

Prepregnancy body mass index (BMI) was calculated from self-reported height and prepregnancy weight. Weight gain during pregnancy was classified based on recent recommendations from the Institutes of Medicine’s Committee to reexamine pregnancy weight guidelines (Rasmussen & Yaktine, 2009). Women were classified by their prepregnancy BMI as being underweight (BMI < 18.5 kg/m<sup>2</sup>), normal weight (BMI 18.5–24.9 kg/m<sup>2</sup>), overweight (BMI 25–29.9 kg/m<sup>2</sup>), or obese (BMI ≥ 30 kg/m<sup>2</sup>), and then categorized as having gained “less than appropriate,” “appropriate,” or “more than appropriate” amount of weight based on their prepregnancy BMI and weight change during pregnancy (i.e., at delivery), based on Institute of Medicine criteria (Rasmussen & Yaktine, 2009).

Finally, the possession of a social security number (SSN) was used as a proxy variable for legal immigration status among foreign born Latinas only, that is, those with a SSN were considered “documented” and those without a SSN were considered “undocumented.”

### *Data Analysis*

Statistical analyses were performed using SAS version 9.1 (SAS Institute, Cary, NC). Univariate analysis was performed using chi-square and Student’s *t* test. Multivariable analysis was performed to assess for confounders, and we used a priori knowledge of pregnancy risk factors and the “change in effect estimate” criterion to select as covariates those variables whose inclusion changed the odds ratio (OR) point estimate by 10% or more (Rothman & Greenland, 1998). We calculated crude and adjusted ORs and 95% confidence intervals (95% CIs) using logistic regression for LBW, preterm birth, and SGA. We compared the following populations in separate regression models: 1) U.S.-born Latinas versus Whites, 2) foreign-born Latinas versus Whites, and 3) foreign-born versus U.S.-born Latinas. For a subanalysis among foreign-born Latinas only, we also compared documented versus undocumented women for odds of the three outcome variables. The final adjusted logistic regression models were adjusted for maternal age, parity, highest education level completed, marital status, presence of maternal medical risk factor, presence of a pregnancy complication, smoking or alcohol use during pregnancy, and prepregnancy BMI (Table 1).

**Table 1**  
Demographic and Clinical Characteristics of Latinas and Whites with Singleton Live Births in Utah, 2004–2007

Characteristic	Whites (n = 164,690)		U.S.-Born Latinas (n = 10,122)		Foreign-Born Latinas (n = 21,805)	
	%	n	%	n	%	n
Maternal age (yrs)						
<20	5.1	8,332	21.6	2,188	10.7	2,329
20–34	86.2	141,975	73.8	7,469	77.7	16,950
≥35	8.7	14,381	4.6	465	11.6	2,526
Maternal education						
<12 years	7.3	11,925	31.9	3,180	58.3	12,310
Married	86.9	143,180	51.1	5,170	61.2	13,341
Started prenatal care in first trimester	84.0	136,530	70.0	6,882	65.1	13,717
Primiparous	34.3	56,375	38.7	3,896	28.7	6,216
Male infant	51.5	84,857	50.9	5,148	51.1	11,138
Maternal risk factors*	9.2	15,197	10.4	1,056	5.3	1,165
Pregnancy complications†	14.7	24,239	17.0	1,717	17.9	3,910
Type 1 or 2 diabetes‡	0.5	813	0.7	74	0.7	156
Gestational diabetes‡	2.4	3,980	3.2	319	5.5	1,201
Induced delivery	37.5	61,779	30.6	3,092	20.2	4,395
Used alcohol during pregnancy	1.1	1,760	1.8	182	0.3	66
Smoked during pregnancy	6.6	10,828	9.2	929	0.6	122
prepregnancy BMI (kg/m <sup>2</sup> )						
<18.5 (underweight)	5.7	9,278	5.5	545	4.9	912
18.5–24.9 (normal weight)	59.1	95,938	50.6	4,978	52.2	9,767
25–29.9 (overweight)	20.5	33,309	23.0	2,268	28.2	5,269
≥30 (obese)	14.6	23,739	20.8	2,051	14.8	2,762
Adequate pregnancy weight gain						
Less than appropriate	18.0	29,279	19.5	1,923	25.4	4,746
Appropriate	38.8	62,955	33.2	3,263	36.2	6,770
More than appropriate	43.2	70,030	47.3	4,656	38.5	7,194
Mother did not have a SSN§	N/A		N/A		60.6	13,208

Abbreviations: BMI, body mass index; N/A, not applicable; SSN, social security number.

Note: Not all n or percents add up to the column total owing to missing values for some variables; maximum number of missing values was n = 559 for U.S.-born Latinas, n = 3,552 for foreign-born Latinas, and n = 4,566 for Whites in the “Adequate pregnancy weight gain” category.

\* Maternal risk factors: Cardiac disease, acute or chronic lung disease, hemoglobinopathy, chronic hypertension, renal disease, or preexisting diabetes types 1 or 2.

† Pregnancy complications: Anemia, genital herpes, polyhydramnios or oligohydramnios, pregnancy-induced hypertension, eclampsia, uterine bleeding, Rh sensitization, or gestational diabetes.

‡ Diabetes type 1 or 2 is a part of the maternal risk factor category, and gestational diabetes is a part of the pregnancy complications category, but also shown separately in this table.

§ Foreign-born Latina mothers were considered “documented” if they had a SSN listed on the birth certificate, and “undocumented” if they did not.

To estimate the impact of differential misclassification in gestational age by ethnicity, we used the inclusion criteria specified by a U.S. national reference for fetal growth to identify implausible birth weight for gestational age combinations and removed these observations (Alexander, et al., 1996). Logistic regression models were then rerun to determine whether omitting these observations would alter our original results or conclusions.

This study utilized only deidentified data, was approved by the Utah State Registrar of Vital Records and Statistics, and was deemed exempt by the University of Utah Institutional Review Board.

## Results

There were 215,249 live births in Utah between January 1, 2004, and December 31, 2007. This included 209,058 singleton

deliveries, of which 197,017 (94%) were to Latina and White women. Of these, a total of 196,617 (99.8%) births to Latinas and Whites met our inclusion criteria, including 10,122 (5%) U.S.-born Latinas, 21,805 (11%) foreign-born Latinas, and 164,690 (84%) Whites. Based on the “Hispanic origin” and birthplace data from the birth certificate, the majority of foreign-born Latinas originated from Mexico (81%). U.S.-born Latinas were also primarily of Mexican ancestry (73%), and most were born in Utah (52%) versus other U.S. states. The majority of Whites were also born in Utah (65%). Using the SSN as a proxy for legal status in the U.S. among foreign-born Latinas only, we found the majority to be “undocumented” (61%).

We compared Whites, U.S.-born Latinas, and foreign-born Latinas for the prevalence of major demographic and medical risk factors and found substantial differences between the groups (Table 1). Whites were more likely to have completed a high school education and be married than the two Latina groups. Although U.S.-born Latinas were more likely to have completed high school compared with foreign-born Latinas, they more often had teenage pregnancy, were primiparous, had a pregnancy complication, used tobacco/alcohol, were obese, gained more than appropriate weight, and were less often married than foreign-born Latinas. Foreign-born Latinas were less likely to initiate prenatal care during the first trimester (65%) compared with U.S.-born Latinas (70%) and Whites (84%). Of note, foreign-born Latinas more often had missing data, particularly for the appropriate weight gain variable: 16.3% of foreign-born Latinas had missing data, whereas 12.9% of U.S.-born Latinas and just 2.8% of Whites had missing data for maternal height or weight (both of which were needed to calculate BMI). The prevalence of LBW, preterm birth, SGA, and mean birth weight also differed in each population (Table 2). Foreign-born Latinas had the same prevalence of preterm birth as Whites, yet a lower prevalence of all three outcomes compared with U.S.-born Latinas.

U.S.-born Latinas had an increased risk for all three outcomes when compared with Whites (Table 3). After adjustment for confounders, this increased risk was attenuated but remained elevated for the LBW and SGA outcomes, but U.S.-born Latinas and Whites were at similar risk for preterm birth in the adjusted model. Foreign-born Latinas had an increased risk for LBW and SGA when compared with Whites in unadjusted models; however, in the adjusted models the increased risk of SGA persisted yet foreign-born Latinas were at similar risk for LBW and lower risk for preterm birth compared with Whites. Therefore, regardless of birthplace, Latinas generally had either a similar or increased risk of adverse birth outcomes compared with Whites with the exception of preterm birth being less likely among foreign-born Latinas in the adjusted OR. Among Latinas, foreign-born Latinas had a lower risk for all three birth outcomes than U.S.-born Latinas, with an estimated 10% to 20% lower risk based

**Table 2**  
Prevalence of Adverse Birth Outcomes and Mean Birth Weight in Utah among Live, Singleton Births, 2004–2007

	Whites (n = 164,690)	U.S.-Born Latinas (n = 10,122)	Foreign-Born Latinas (n = 21,805)
Low birth weight	5.0	7.2	5.8
Preterm birth	8.1	10.0	8.0
Small for gestational age	6.8	10.1	8.5
Mean birth weight (g)	3,311 ± 513	3,201 ± 528	3,275 ± 530

Note: Data are presented as a percent, or number of grams (mean ± standard deviation).

**Table 3**  
Risk for Adverse Birth Outcomes in Utah among Live, Singleton Births, 2004–2007

	LBW, OR (95% CI)	Preterm Birth, OR (95% CI)	SGA, OR (95% CI)
<b>Crude ORs</b>			
1. U.S.-born Latinas vs. Whites	1.46 (1.35–1.58)	1.26 (1.18–1.35)	1.53 (1.43–1.64)
2. Foreign-born Latinas vs. Whites	1.16 (1.09–1.23)	0.98 (0.93–1.04)	1.27 (1.21–1.34)
3. Foreign-born vs. U.S.-born Latinas	0.79 (0.72–0.87)	0.78 (0.72–0.85)	0.83 (0.77–0.90)
4. Documented vs. undocumented foreign-born Latinas	0.93 (0.82–1.04)	1.05 (0.95–1.17)	0.82 (0.75–0.91)
<b>Adjusted ORs*</b>			
5. U.S.-born Latinas vs. Whites	1.14 (1.05–1.25)	1.04 (0.96–1.12)	1.27 (1.18–1.36)
6. Foreign-born Latinas vs. Whites	0.95 (0.88–1.03)	0.85 (0.79–0.91)	1.14 (1.06–1.21)
7. Foreign-born vs. U.S.-born Latinas	0.78 (0.69–0.87)	0.79 (0.72–0.87)	0.88 (0.80–0.97)
8. Documented vs. undocumented foreign-born Latinas†	1.08 (0.94–1.24)	1.15 (1.02–1.30)	0.93 (0.83–1.05)

Abbreviations: CI, confidence interval; OR, odds ratio; LBW, low birth weight; SGA, small-for-gestational age.

Note missing observations: missing  $n = 0$  for all crude ORs (models 1–4),  $n = 4,435$  for model 5,  $n = 7,642$  for model 6,  $n = 4,095$  for model 7, and  $n = 3,651$  for model 8 in the adjusted ORs.

\* Adjusted for maternal age, parity, education, marital status, maternal risk factors (cardiac disease, acute or chronic lung disease, hemoglobinopathy, chronic hypertension, renal disease, or preexisting diabetes types 1 or 2), pregnancy complications (anemia, genital herpes, polyhydramnios or oligohydramnios, pregnancy-induced hypertension, eclampsia, uterine bleeding, Rh sensitization, or gestational diabetes), smoking and alcohol use, and prepregnancy body mass index.

† Foreign-born Latina mothers were considered “documented” if they had a SSN listed on the birth certificate, and “undocumented” if they did not.

on the adjusted ORs. In the subanalysis among foreign-born Latinas only, crude and adjusted ORs showed that documented women were not any different than undocumented women in their risk for LBW or SGA, and had a slightly elevated risk of preterm birth.

We initially included maternal weight gain (which was based on maternal BMI and change in weight during pregnancy) in the adjusted regression models in the analysis, because this is an important variable to consider for birth outcomes. However, our results did not change substantially when this variable was added to the models for U.S.-born Latinas, and although the ORs were slightly attenuated for comparisons with foreign-born Latinas, they also had greater than 16% missing data for this variable (owing to more frequent missing values for height), and thus unreliable results (data not shown). Including prepregnancy BMI in the final adjusted regression models resulted in less missing data, yet the results were still generally unchanged. Furthermore, when we examined implausible birth weight for gestational age combinations to see how this might change our ORs, the results comparing all groups for each of the primary outcomes (as above) were unchanged (data not shown).

## Discussion

### New Contribution to the Literature

This study confirmed a variation of the Latina epidemiologic paradox among singleton births in Utah favoring birth outcomes for foreign-born Latinas over U.S.-born Latinas. U.S.-born Latinas had a similar or greater risk of adverse outcomes compared with Whites and foreign-born Latinas. These findings highlight the importance of stratifying Latinas by country of origin. Although foreign-born Latinas were more likely to experience “adverse” socioeconomic risk factors compared with Whites and U.S.-born Latinas, they had a consistently lower risk for preterm birth, LBW and SGA than U.S.-born Latinas. In our subanalysis among foreign-born Latinas only, our findings showed that undocumented women comprised more than half of this group and were generally not at greater risk than documented women for LBW, preterm birth, or SGA, despite their lack of legal immigration status in the United States (using SSN as an indirect measure of legal status).

### Comparisons with Prior Research

Previous studies suggest that Latinas have the lowest prevalence of LBW and are less likely to deliver LBW infants (compared with Whites; Brown, et al., 2007; González-Quintero, et al., 2006; Hessol & Fuentes-Afflick, 2000). A much smaller body of literature has focused on other birth outcomes besides LBW. For instance, one study found that Latinas also had a lower prevalence of SGA and lower odds for preterm birth compared with White women in North Carolina (Brown, et al., 2007) and another found U.S.-born Mexican-Americans to have a slightly greater risk for preterm birth than Mexican-born women in Washington (Crump, Lipsky, & Mueller, 1999). Although in our study U.S.-born Latinas had on average higher levels of education, more frequent initiation of prenatal care in the first trimester, and possessed a SSN far more often than foreign-born Latinas, they actually had more “adverse” behavioral risk factors compared with foreign-born Latinas. This finding may explain their increased risk for the three birth outcomes studied; however, the impact of education may not be uniform among the three populations we studied, because this variable reflected number of years in school and did not assess quality of education. In addition, foreign-born Latinas may nonetheless receive health education within their homes or communities (i.e., outside of the classroom), despite fewer average years of education compared with U.S.-born Latinas.

A recent study done in California was based on birth certificate data augmented with survey data (Hoggatt, Flores, Solorio, Wilhelm, & Ritz, 2011). The authors performed some analyses similar to the comparisons we did. However, there was little evidence that either U.S.-born Latinas or foreign-born Latinas had a lower prevalence of LBW regardless of the variables included in the logistic regression models, that is, little indication of a “Latina paradox” when compared with Whites in this study. For this Los Angeles-based population, the authors concluded that overall, these results were not consistent with the “Latina epidemiologic paradox.” There may be differences between the Latinas surveyed in this California study and the Latinas in Utah’s rapidly growing Latina population that could account for the differences.

A Utah study examining LBW from 2000 to 2003 found that, although foreign-born Mexican women had a lower prevalence of LBW than other Latina subgroups, they still had a higher prevalence than White women (Dyer, Hunter, & Murphy, 2011).

The authors also found that social support (particularly from the husband) and maternal social network size were positively associated with birth weight. We found that U.S.-born Latinas in Utah are less likely to be married than foreign-born Latinas and Whites; thus, they may have less social support, which may further contribute to their increased risk for LBW. Moreover, because of the strong influence of healthy lifestyle habits (e.g., not smoking, not drinking alcohol and caffeine) promoted by the predominant Church of Latter Day Saints (Mormon religion) in Utah, our White population may actually be “healthier” than White populations overall in other states (Enstrom & Breslow, 2008). This might decrease adverse pregnancy outcomes among White Utahans, thus eliminating the gap in adverse outcomes between Whites and Latinas. However, we still found foreign-born Latinas to have a lower risk for preterm birth than Whites in our study when adjusting for confounders. In contrast to other states with long-established and large Latino populations, Utah has a fairly new and growing Latino population (Korinek & Smith, 2011; United States Census Bureau, 2000; 2005).

Other possible mechanisms explaining the Latina paradox have also been investigated. For instance, Latinas, particularly foreign-born Latinas, may have healthier lifestyles (including better nutrition, lower rates of smoking and alcohol consumption) and possibly a higher regard for parental roles (Collins & Shay, 1994; Hedderson & Daudistel, 1982; Lethbridge-Çejku, Schiller, & Bernadel, 2004; Winkleby & Cubbin, 2004). Another hypothesis has been described where migration may select out healthier individuals, namely, immigrant Latinas living in the United States (the “healthy migrant effect”). Urban poverty may negatively impact birth weight when the mother is a U.S.-born Latina, but not if she immigrated from another country (Collins & Shay, 1994; Williams, et al., 1986). Associations between known risk factors and LBW among Latinas may also be modified by acculturation (Hoggatt et al., 2011). However, the exact mechanism for the Latina paradox remains unknown.

### *Strengths and Limitations*

This study benefits from a rigorous design, which bolsters its external validity. Several important strengths include the very large sample size, allowing us to stratify on many different factors simultaneously. Our analysis included the clinically important birth outcomes of LBW, preterm birth, and SGA, the latter two of which have received little attention in previous research on the Latina paradox. We also considered U.S.-born Latinas separately from foreign-born Latinas, as well as documented versus undocumented foreign-born Latinas; this has not consistently been done in birth outcomes research on this paradox. Furthermore, using a clinical estimate of gestational age in our study may be more accurate than data that rely only on the last menstrual period (LMP)-based gestational age estimate (Klebanoff, 2007; Mustafa & David, 2001). Studies comparing LMP-based gestational age with clinical estimates of gestational age (which may include LMP data, ultrasound data, and other clinical information) have found that clinical estimates are more highly correlated with birth weight than LMP-based estimates (Hammes & Treloar, 1970; Taback, 1951). However, using a clinical estimate of gestational age may limit comparability of this study's findings to other studies using LMP-based data.

Despite the strengths of our study, birth certificate records have important limitations. Data on Hispanic origin was

missing for a very small proportion of all Utah women with singleton births (<0.5%), and had to be excluded from the analyses. Data on some covariates relevant to studying the Latina paradox were not included in the birth certificates (e.g., income) or may have been underreported (e.g., tobacco/alcohol use); thus, we were unable to include variables such as income, health insurance status and language preference in our analyses. Differences in social support structure and acculturation (Ceballos & Palloni, 2010) among foreign-born and U.S.-born Latinas may also be important factors (Hoggatt et al., 2011), but we did not have these variables and thus were unable to address these issues in our analyses. Because we used deidentified data, a small number of women may have had more than one birth during the 4-year study period and thus could have been included more than once. Although race/ethnicity misclassification is possible, previous research has found race/ethnicity data for Latinas from birth certificates to have high sensitivity (99.0%) and positive predictive value (96.4%) compared with postpartum face-to-face interviews (Baumeister, Marchi, Pearl, Williams, & Braveman, 2000). Finally, it is possible that misclassification of gestational age was more likely than misclassification of infant birth weight in our data; however, we deleted implausible birth weight for gestational age combinations and reran the analysis, and our results were unchanged.

The differences in risk factors and birth outcomes we identified between foreign-born and U.S.-born Latinas may require specific approaches to promote protective factors among Latinas to decrease their risk of adverse birth outcomes. This is an opportunity to test prevention efforts targeting the specific high-prevalence risky behaviors we identified among U.S.-born Latinas (e.g., smoking, teenage pregnancy). Success in these efforts will demand consideration of the different composition of foreign-born and U.S.-born Latinas in local and state populations. Other strategies to improve pregnancy outcomes among Latinas should be considered, such as public health strategies that encourage U.S.-born Latinas to retain some of the healthier behaviors of their foreign-born counterparts.

One opportunity to emphasize social supports is the use of group prenatal care visits, as employed in the “Centering Pregnancy” model. This innovative model of care delivery provides substantial health promotion content by using peer support and self-management training activities (Klima, Norr, Vonderheid, & Handler, 2009; Manant & Dodgson, 2009), and has been successful in Latina populations (Robertson, Aycock, & Darnell, 2009). Such a model would allow relationships to develop between U.S.-born and foreign-born Latinas, encouraging social support, under the guidance of a clinician. Furthermore, because of the alarming rate of teenage pregnancy among the U.S.-born Latinas, we feel prevention efforts need to better reach this group to provide contraception to delay childbearing.

Because there remains much yet to learn about the causes for differences between U.S.-born and foreign-born Latinas in their risk for adverse birth outcomes, we also support calls for more research on this topic, keeping in mind that it is essential to stratify Latinas by birthplace. Maternal country of birth, language, and acculturation are important to investigate as culturally appropriate interventions are developed. Genetics and gene-environment interactions may also contribute to the risk of adverse birth outcomes and should be evaluated. Future studies may further examine how acculturation in different regions of the United States leads to the loss of any perinatal advantage in the underprivileged Latino community.

## Conclusion

LBW and preterm birth are important predictors of infant morbidity and mortality. Despite significant treatment advances in caring for LBW and preterm infants, resulting in decreased mortality, prevention efforts have not yet reduced the prevalence of these adverse birth outcomes in the United States (Behrman & Stith Butler, 2007; Chung, Boscardin, Garite, Lagrew, & Porto, 2003; Fuentes-Afflick, et al., 1998; Hessel & Fuentes-Afflick, 2005; Mansour, Eissa, Nofal, Kharboush, & Reda, 2005; Wilcox & Russell, 1983). Thus, finding ways to decrease LBW and preterm births remains a public health priority (Behrman & Stith Butler, 2007; Fuentes-Afflick, et al., 1998). The U.S. population is diverse; prevention efforts should address ethnic group-specific risk factors and be culturally appropriate, particularly in the large and growing Latino population (U.S. Census Bureau, 2004). Improvement of health disparities through education alone may not apply to these adverse pregnancy related outcomes found among Latinas in this study. Our results indicating that outcomes were worse for the segment of the Latina population that was born in the United States and had greater education suggest that alternative strategies for this group are necessary to reduce adverse birth outcomes.

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### Author Descriptions

Marie E.S. Flores, MD, PhD, MPH, is a recent graduate of the University of Utah School of Medicine, Salt Lake City, Utah, and currently in the Family and Social Medicine Residency Program at Einstein/Montefiore Medical Center in New York City. Her research interests include epidemiology, public health, maternal and child health, and reproductive health access in medically underserved populations.

Sara E. Simonsen, PhD, MSPH, CNM, is a visiting instructor in the Division of Public Health, Department of Family and Preventive Medicine, University of Utah School of

Medicine, Salt Lake City, Utah. Her research interests include reproductive health, fertility, pregnancy, labor and delivery, and women's health.

Tracy A. Manuck, MD, is an assistant professor in the Department of Obstetrics and Gynecology, University of Utah, Salt Lake City, Utah. Her research interests include maternal–fetal medicine, preterm birth, multiple gestations, and pharmacogenomics.

Jane M. Dyer, CNM, FNP, MBA, PhD, FACNM, is an assistant professor in the College Of Nursing, University Of Utah, Salt Lake City, Utah. Her research interests include the impact of positive and negative health behaviors on the perinatal outcomes of immigrant and refugee women.

David K. Turok, MD, MPH, is an associate professor in the Department of Obstetrics and Gynecology, University of Utah, Salt Lake City, Utah. His research interests include increasing access to highly effective contraception and use of the IUD for emergency contraception.