Testing the Epidemiologic Paradox of Low Birth Weight in Latinos

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Background: Rates of low-birth-weight (LBW) infants are similar between Latina and white women, an epidemiologic paradox. However, few studies have analyzed the relationship between ethnicity, Latino subgroup, confounding variables, and LBW.

Methods: We analyzed 395,070 singleton livebirths to Latina and non-Latina white women in California during 1992. Multivariate logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for the risks due to Latino ethnicity and Latino subgroup for very LBW (VLBW, 500-1499 g) and moderately LBW (MLBW, 1500-2499 g) outcomes.

Results: Latina and white women had similar unadjusted rates of VLBW (0.7% vs 0.6%) and MLBW infants (3.7% vs 3.4%). After adjusting for maternal age, education, birthplace, marital status, parity, tobacco use, use of prenatal care, infant sex, and gestational age, there was no difference in the odds of VLBW infants between Latina and white women (OR, 0.93 [95% CI, 0.81-1.07]). Latina women had minimally elevated odds of MLBW infants (OR, 1.06 [95% CI, 1.01-1.11]) compared with white women. By Latino subgroup, there was no difference in the adjusted odds of VLBW infants among Central and South American, Cuban, Mexican, Puerto Rican, and white women. The adjusted odds of MLBW infants were elevated among Central and South American (OR, 1.14 [95% CI, 1.05-1.25]) and Puerto Rican women (OR, 1.41 [95% CI, 1.12-1.78]), relative to white women.

Conclusions: The epidemiologic paradox of LBW in Latinos is valid. New conceptual models are needed to identify Latina women who are at risk for adverse pregnancy outcomes.


Editor’s Note: The paradox of low incidence of low-birthweight infants among Latina women despite high-risk demographics continues. “A saber.”

Catherine D. DeAngelis, MD

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LOW-BIRTH-WEIGHT (LBW) infants have a higher risk for morbidity and mortality than non-LBW infants, and in the United States, African American women have higher rates of LBW infants than non-Latina white women. Latinos are the second largest ethnic minority group in the United States, and they are socioeconomically disadvantaged relative to whites. Although minority race and ethnicity and socioeconomic disadvantage are associated with an increased risk for LBW infants, Latina and white women have similar rates of LBW infants, an epidemiologic paradox. By Latino subgroup, LBW rates are also similar among Central and South American, Cuban, Mexican, and white women.

There is no definitive explanation for the epidemiologic paradox. Behavioral factors such as tobacco use may contribute to the paradox, since Latina women have lower rates of tobacco smoking than white women. Nutritional status may also be important, and Latina women consume more nutritious diets than white women. Cultural factors may be relevant for the epidemiologic paradox, since foreign-born Latina women have lower rates of LBW infants than US-born women. Our understanding of the epidemiologic paradox is limited, however, since most studies of LBW in Latinos have not adjusted for confounding variables. The objective of our study was to test the epidemiologic paradox of LBW among Latinos in California and to measure the relationships between LBW and Latino ethnicity and national origin subgroup. We analyzed the California birth certificate database, since nearly 40% of all US Latino births occur in California.
MATERIALS AND METHODS

From the 1992 California birth certificate database, we selected singleton infants born to Latina and white women, using the information on maternal race and ethnicity and Hispanic origin that is obtained during standard data collection for the birth certificate. White women were defined as being non-Hispanic origin (n = 223,090). Latina women were identified by the information recorded in the Hispanic ethnic origin data field. Since most Latina women (99.5%) were coded as white race, we excluded the small subset of Latina women (0.5%) who were coded as Asian, black, or Native American. From the group of white Latina women, we retained women from the 4 national origin subgroups that are separately identified on the California birth certificate, ie, Central and South American, Cuban, Mexican, and Puerto Rican (n = 249,500), and we excluded women who were identified as Latina of other origin (n = 25,624).

We defined the following mutually exclusive dependent variables using infant birth weight: extremely low (<500 g), very low (VLBW, 500-1499 g), moderately low (MLBW, 1500-2499 g), normal (2500-4000 g), and high (>4000 g). We distinguished between VLBW and MLBW infants because the risk factors for these outcomes differ. For the multivariate analyses of LBW outcomes, we excluded infants who weighed less than 500 g (0.06% of births), because we were concerned about the accuracy of recorded birth weights in this category, and we excluded births with missing data for any study variable (2.6% of births). We excluded high-birth-weight infants from the multivariate analyses of LBW outcomes and used normal-birth-weight infants as the reference category, since high-birth-weight infants have different perinatal outcomes than normal-birth-weight infants.

The primary independent variables were maternal race and ethnicity (Latina and white) and Latino subgroup. Foreign- and US-born women were included in the group of Latina women, including each subgroup. We also analyzed maternal age (<18, 18-34, and ≥34 years), education (<12 and ≥12 years), marital status, birthplace (50 states and the District of Columbia vs US territories and outside the United States), number of previous livebirths (parity [0, 1-3, and ≥3]), tobacco use, use of prenatal care, infant sex, and gestational age. Marital status was imputed on the California birth certificate, and the assignment of "apparently unmarried" was based on a comparison of parental surnames. This method of coding aggregates parents who had the same surname and parents for whom surname information was missing. Tobacco use was coded as a dichotomous variable (present or absent) in the pregnancy complications data field. This coding method aggregates women who reported no tobacco use and women for whom this information was missing. Use of prenatal care was categorized according to the Kotelchuck Adequacy of Prenatal Care Utilization Index as inadequate, intermediate, adequate, and adequate plus. For example, women with adequate use entered prenatal care before the fifth month of pregnancy and received 80% to 100% of recommended services. Women in the adequate plus category probably had a high-risk pregnancy that required a high level of prenatal care. Thus, whereas adequate plus use is not a causal factor for LBW, we included it in the analyses to properly control for use of care. Gestational age was recorded directly on the birth certificate, and we created the following 3 categories: very premature (<231 days), moderately premature (231-258 days), and nonpremature (≥258 days).

We performed bivariate analyses of maternal characteristics and pregnancy outcomes between Latina and white women and among the 4 Latino subgroups using χ² statistics. Logistic regression was used to estimate unadjusted and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for the association between maternal ethnicity and Latino subgroup with VLBW and MLBW outcomes. Variables included in the regression models were maternal age, education, marital status, birthplace, parity, tobacco use, use of prenatal care, infant sex, and gestational age. We first analyzed maternal ethnicity as the independent variable (model 1), then Latino subgroup (model 2), using white women as the reference category and the same set of covariates. Commercially available software (SAS) was used for all statistical analyses.

To estimate the contribution of risk factors to overall LBW rates, we calculated attributable risks and 95% CIs for the following maternal characteristics that are potentially modifiable and may be causally associated with LBW outcomes: maternal age younger than 18 and older than 34 years, more than 3 previous livebirths, tobacco use, and inadequate use of prenatal care. For these calculations we used the proportion of women exposed to each risk factor and the adjusted ORs from the multivariate analyses as approximations of the relative risk.

RESULTS

A total of 395,070 infants who weighed 500 to 4000 g and had complete information for all variables was included in the multivariate analyses of VLBW and MLBW outcomes (VLBW, n = 2783; MLBW, n = 15,655; normal, n = 376,632). There was no difference between Latina and white women in the proportion of births with missing information on maternal age (0.02% vs 0.02%; P = .40), birthplace (0% vs 0%), parity (0.06% vs 0.07%; P = .10), or birth weight (0.01% vs 0.02%; P = .20). Latina women were more likely to be missing information on education (0.7% vs 0.5%; P = .001) and use of prenatal care (2.0% vs 1.4%; P = .001), and white women were more likely to be missing information on gestational age (2.9% vs 2.5%; P = .001).

COMPARISON OF LATINA AND WHITE WOMEN

Latina women generally had a less favorable profile of maternal characteristics than white women (Table 1). Latina women were more than twice as likely to be younger than 18 years, 5 times more likely to have less than 12 years of education, twice as likely to be unmarried, twice as likely to have had more than 3 previous livebirths, and 3 times more likely to have inadequate use of prenatal care than white women. On the other hand, white women were more than 3 times more likely to be...
US-born than Latinas and 6 times more likely to use tobacco during pregnancy.

Despite these differences in maternal characteristics, Latina and white women had a similar incidence of VLBW (0.7% vs 0.6%) and MLBW infants (3.7% vs 3.4%) (Table 1). This similarity is consistent with the epidemiologic paradox. The incidence of very premature infants was also similar between Latina and white women, although the incidence of moderately premature infants was 36% higher among Latina women.

In unadjusted logistic regression analyses, Latina women had slightly higher odds of VLBW (OR, 1.10 [95% CI, 1.01-1.19]) and MLBW infants (OR, 1.04 [95% CI, 1.01-1.08]) (Table 2) than white women. After adjusting for maternal and infant characteristics, there was no difference in the odds of VLBW infants between Latina and white women (OR, 1.03 [95% CI, 0.98-1.08]). The adjusted odds of MLBW infants remained slightly elevated among Latina (OR, 1.06 [95% CI, 1.01-1.11]) relative to white women. Thus, multivariate adjustment for maternal and infant characteristics reduced the odds of VLBW infants associated with maternal Latino ethnicity, although there was essentially no change in the slightly elevated risk for MLBW infants among Latinas.

**COMPARISON BY LATINO SUBGROUP**

Latina women of Mexican origin were the largest subgroup (87.1% of total Latino sample) (Table 1), and Central and South American women were the second largest subgroup (11.8%). Overall, Mexican and Puerto Rican women had the least favorable profile of maternal characteristics. Mexican and Puerto Rican women had the highest proportion of women who were younger than 18 years. Mexican women had the highest proportion of women with less than 12 years of education, more than 3 previous livebirths, and inadequate use of prenatal care. Puerto Rican women had the highest proportion of Latina women who reported tobacco use. Virtually all Central and South American women were foreign-born, and nearly half were unmarried. Relative to white women, Latina women from all 4 subgroups were more likely to be for-
eign-born and were less likely to use tobacco during pregnancy (Table 1). Central and South American, Mexican, and Puerto Rican women were also significantly more likely to be younger, to have less than 12 years of education, to be unmarried, to have more than 3 previous livebirths, and to have inadequate use of prenatal care than white women.

Despite these subgroup differences in maternal characteristics, the crude incidence of VLBW infants was similar among Central and South American, Cuban, Mexican, Puerto Rican, and white women (Table 1). On the other hand, the incidence of MLBW infants was approximately 50% higher among Puerto Rican than Central and South American, Cuban, Mexican, or white women. Among Latinas, Puerto Rican women had the highest incidence of very premature infants, and Central and South American women had the highest incidence of moderately premature infants. Relative to white women, the incidence of very premature and moderately premature infants was higher among Central and South American, Mexican, and Puerto Rican women.

In unadjusted logistic regression analyses, Central and South American women were 30% more likely to have VLBW infants than white women, and Puerto Rican women had 48% higher odds of MLBW infants than white women (Table 2). After adjusting for maternal and infant characteristics, there was no difference in the odds of VLBW infants between any Latino subgroup and white women. The adjusted odds of VLBW infants remained significantly elevated among Puerto Rican women (OR, 1.41 [95% CI, 1.12 to 1.78]) relative to white women. Central and South American women were slightly more likely to have MLBW infants than white women after adjusting for maternal and infant characteristics (OR, 1.14 [95% CI, 1.05 to 1.25]). Thus, adjusting for maternal and infant characteristics reduced the odds of VLBW infants among Central and South American women and increased the odds of MLBW infants in this subgroup. There was no change in the odds of MLBW infants among Puerto Rican women in the unadjusted and adjusted analyses.

### OTHER PREDICTORS OF LBW OUTCOMES

As expected,1 women who were older than 34 years, had less than 12 years of education, had no previous livebirths, and had adequate plus use of prenatal care were more likely to have VLBW and MLBW infants than women from the reference categories (Table 3). Very premature and moderately premature infants were also much more likely to be VLBW and MLBW than nonpremature infants. The odds of MLBW infants were elevated among women who were unmarried, used tobacco, and had inadequate use of prenatal care. Women who were younger than 18 years and foreign-born were less likely to have MLBW infants than women who were 18 to 34 years old and US-born.

### ATTRIBUTABLE RISK

In Latina and white women, older maternal age was associated with the highest attributable risk for VLBW infants, and inadequate use of prenatal care had the highest attributable risk for MLBW infants (Table 4). We estimated that 4% to 8% of VLBW infants in Latina and white women could be prevented if older women had the same risk as women of intermediate age, and 13% to 30% of MLBW infants might be prevented if Latina and white women with inadequate use of prenatal care had the same risk as women with adequate use. On the other hand, reducing the proportion of younger childbearing Latina and white women would be expected to slightly increase the proportion of MLBW infants.

### COMMENT

The epidemiologic paradox of LBW in Latinos was described more than 10 years ago,2 and the results of our California study demonstrate that in 1992, there was still an epidemiologic paradox of LBW among Latinos. To our knowledge, our study is the first to document the validity of the epidemiologic paradox in a large, recent sample of births and to use multivariate analysis to adjust for po-
Table 3. Logistic Regression Adjusted Odds Ratios for Very and Moderately Low-Birth-Weight Outcomes, California, 1992

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Very Low Birth Weight†</th>
<th>Moderately Low Birth Weight‡</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inadequate use of prenatal care</strong></td>
<td>0.89 (0.72 to 1.10)</td>
<td>0.88 (0.81 to 0.95)</td>
</tr>
<tr>
<td><strong>Tobacco use</strong></td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Parity</strong></td>
<td>1.16 (1.02 to 1.32)</td>
<td>1.19 (1.14 to 1.25)</td>
</tr>
<tr>
<td><strong>Marital status</strong></td>
<td>1.16 (1.02 to 1.32)</td>
<td>1.19 (1.14 to 1.25)</td>
</tr>
<tr>
<td><strong>Birthplace</strong></td>
<td>1.16 (1.02 to 1.32)</td>
<td>1.19 (1.14 to 1.25)</td>
</tr>
<tr>
<td><strong>Use of prenatal care</strong></td>
<td>1.16 (1.02 to 1.32)</td>
<td>1.19 (1.14 to 1.25)</td>
</tr>
<tr>
<td><strong>Infant sex</strong></td>
<td>0.96 (0.87 to 1.14)</td>
<td>0.93 (0.88 to 0.97)</td>
</tr>
<tr>
<td><strong>Gestational age</strong></td>
<td>0.95 (0.85 to 1.06)</td>
<td>1.19 (1.15 to 1.24)</td>
</tr>
<tr>
<td><strong>Birthplace</strong></td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Parity, No. of previous livebirths</strong></td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Tobacco use</strong></td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Use of prenatal care</strong></td>
<td>1.00</td>
<td>1.00</td>
</tr>
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<td><strong>Infant sex</strong></td>
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<td>1.00</td>
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</tr>
<tr>
<td><strong>Gestational age</strong></td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Indicates 500 to 1499 g (n = 2783).
†Indicates 1500 to 2499 g (n = 15 655).
‡Indicates reference category.
§Categories are described in Table 1 and in the “Materials and Methods” section of the text.

Table 4. Attributable Risk for Very and Moderately Low Birth Weight Associated With Selected Maternal Characteristics, California, 1992

<table>
<thead>
<tr>
<th>Maternal Characteristic</th>
<th>Very Low Birth Weight*</th>
<th>Moderately Low Birth Weight†</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age &lt; 18 y</strong></td>
<td>-2.8 (-6.2 to 1.2)</td>
<td>-2.8 (-6.2 to 1.2)</td>
</tr>
<tr>
<td><strong>Age &gt; 34 y</strong></td>
<td>1.7 (0.7 to 3.7)</td>
<td>1.7 (0.7 to 3.7)</td>
</tr>
<tr>
<td><strong>Parity &lt; 3 previous livebirths</strong></td>
<td>0.7 (0 to 1.5)</td>
<td>0.7 (0 to 1.5)</td>
</tr>
<tr>
<td><strong>Tobacco use</strong></td>
<td>0.5 (-0.7 to 2.1)</td>
<td>0.5 (-0.7 to 2.1)</td>
</tr>
<tr>
<td><strong>Inadequate use of prenatal care</strong></td>
<td>0.95 (0.85 to 1.06)</td>
<td>1.19 (1.15 to 1.24)</td>
</tr>
</tbody>
</table>

*Indicates 500 to 1499 g.
†Indicates 1500 to 2499 g.
low, we believe that ethnic differences in tobacco use do not explain the paradox. Diet and weight gain during pregnancy also differ between Latina and white women, but the California birth certificate does not report information on maternal nutritional status or gestational weight gain, and we were unable to test the hypothesis that nutritional factors contribute to the paradox.

Cultural factors such as acculturation and social support are also hypothesized to contribute to the epidemiologic paradox. In our study, foreign-born support are also hypothesized to contribute to the epidemiologic paradox.7,12,13 In our study, foreign-born Latina women were foreign-born, even a small effect may have a much larger impact at the population level. Our results are consistent with those of previous studies that have reported lower rates or odds of LBW infants among foreign-born Latina women,4,10-13 although most studies have not adjusted for confounding variables. Further study is needed to refine measurements of acculturation, since maternal birthplace is a proxy measure, and the process of acculturation is complex.30

According to the “healthy immigrant” hypothesis, individuals who immigrate have a health advantage relative to nonimmigrants, and immigrants also may retain traditional values or attitudes that are associated with favorable health outcomes.13,37

Alternatively, community factors such as the acculturation of the community and community values may contribute to the epidemiologic paradox.34,38 Communities that retain or promote traditional Latino values, ie, familial integrity, high regard for parental roles, and social support, could exert a favorable influence on pregnancy outcomes among childbearing women within the community, even in the setting of adverse socioeconomic factors.12,33,35,38 Using the California birth certificate database, however, we were unable to test the relationship between community factors and LBW outcomes. Further study must be directed toward measuring acculturation at the community level and defining the relationship between community factors and perinatal health outcomes.

Biological factors such as sexually transmitted diseases may also contribute to the epidemiologic paradox. In the Vaginal Infections and Prematurity Study, Latina and white women were less likely to be infected with Trichomonas vaginalis than black women.39 Although infected women were more likely to have LBW infants than uninfected women, only 1.6% of LBW infants in Latinas was attributable to Trichomonas infection.39 Further study is needed to define the contribution of other biological risk factors to ethnic differences in perinatal outcomes.

Several limitations must be considered. First, cross-sectional epidemiologic studies cannot establish causal relationships between variables, and the breadth of the data that are reported inherently limits birth certificate studies. Marital status is imputed on the California birth certificate, and we could not assess the likelihood of misclassification. Tobacco use during pregnancy is likely underreported on the birth certificate, but the extent of underreporting has not been well documented. However, misclassification of tobacco use would be expected to bias our results toward finding no association. We were unable to analyze several factors that contribute to LBW, including use of alcohol and other drugs and nutritional factors, since the birth certificate does not report information on these variables. The population of Cuban- and Puerto Rican-origin Latina women in our study was small, yet our results are consistent with those of previous studies of LBW outcomes in these Latino subgroups.14,31 Our estimates of attributable risk may be inaccurate if the relationship between the maternal characteristics and LBW outcomes is not causal.21 Finally, we were unable to analyze individual subgroups of Central and South Americans, since the California birth certificate uses a single code for all Latinos of Central and South American origin.

We conclude that the epidemiologic paradox of LBW infants among Latinos is valid and remains unexplained. Further study of cultural factors at the individual and community levels may identify new opportunities for policy interventions to optimize perinatal outcomes in Latinos and other ethnic groups.

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