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Association of Acculturation With Adverse Pregnancy Outcomes

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Abstract

OBJECTIVE: To evaluate the relationship between acculturation and adverse pregnancy outcomes, and whether these relationships differ across racial or ethnic groups.

METHODS: This is a planned secondary analysis of the Nulliparous Pregnancy Outcomes Study (nuMoM2b), a prospective observational cohort study of 10,038 pregnant women at 8 academic health care centers in the United States. Nulliparous pregnant women with singleton gestations were recruited between 6 weeks, 0 days and 13 weeks, 6 days gestational age from October 2010 to September 2013. Acculturation was defined by birthplace (United States versus non-United States), language used during study visits (English or Spanish), and self-rated English proficiency. The adverse pregnancy outcomes of interest were preterm birth (<37 weeks of gestation, both iatrogenic and spontaneous); preeclampsia or eclampsia; gestational hypertension; gestational diabetes; stillbirth; small for gestational age; and large for gestational age. Multivariable

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regression modeling was performed, as was an interaction analysis focusing on the relationship between acculturation and APOs by maternal race or ethnicity.

RESULTS: Of the 10,006 women eligible for this analysis, 8,100 (80.9%) were classified as more acculturated (e.g. born in the U.S. with high English proficiency), and 1,906 (19.1%) were classified as having less acculturation (e.g. born or not born in the U.S. with low proficiency in English or use of Spanish as the preferred language during study visits). In multivariable logistic regression modeling, more acculturation was significantly associated with higher frequency of preterm birth (OR 1.46, aOR 1.50, 95% CI 1.16-1.95); spontaneous preterm birth (OR 1.54, aOR 1.62, 95% CI 1.14-2.24); preeclampsia or eclampsia (OR 1.39, aOR 1.31, 95% CI 1.03-1.67); preeclampsia without severe features (OR 1.44, aOR 1.43, 95% CI 1.03-2.01); and gestational hypertension (OR 1.68, aOR 1.48, 95% CI 1.22-1.79. These associations did not differ by self-described race or ethnicity.

CONCLUSION: In a large cohort of nulliparous women, more acculturation, regardless of self-described race or ethnicity, was associated with increased odds of several adverse pregnancy outcomes.

CLINICAL TRIAL REGISTRATION: ClinicalTrials.gov, .

Précis

In a prospectively evaluated nulliparous cohort, greater acculturation, as measured by English proficiency and place of birth, is associated an increase in with adverse pregnancy outcomes.

INTRODUCTION

In the United States (U.S.), disparities in health outcomes by race and ethnicity have been attributed to multiple, oftentimes synergistic causes, including unequal access to healthcare resources, geographic segregation, language barriers, and socioeconomic status.[1] Although U.S. women of color have increased risk of adverse pregnancy outcomes (APOs) compared to white women, those who have recently immigrated tend to have better outcomes than either their ethnocultural counterparts born in the U.S., or socioeconomically-similar, non-immigrant white women.[2,3] The etiology of this “immigrant paradox” remains uncertain, but is likely multifactorial. Some have hypothesized that immigration is primarily undertaken by the healthiest subpopulations (the “healthy immigrant” hypothesis); others hypothesize that recently immigrated women have not had as much exposure to a U.S. sociocultural structure that systematically disadvantages women of color.[4]

The latter hypothesis rests upon the concept of acculturation, which can be described as the process by which an individual’s or group’s cultural norms may change as a result of acclimating to a new or different cultural setting.[4–9] Acculturation is a complex, dynamic process that is difficult to capture, but several measures have been published.[10] If acculturation, or the process of orienting toward the host culture, results in greater exposure to structural disadvantage or other sociocultural burdens, it may partially account for some of the observed ethnic and racial differences in APOs.[2,3,11–16] Previous analyses of the relationship between acculturation and APOs often utilize large administrative datasets or cohort studies that rely upon self-reported health status or participant recall of pregnancy

outcomes, or are based upon data which are decades old.[2,12,17–23] These studies frequently lack detailed, reliable pregnancy-related clinical information, making it difficult to adjust for relevant clinical confounders or ascertain APOs with certainty.

Therefore, we aimed to address this gap using data from a large, contemporary, and diverse population of nulliparous pregnant women who were prospectively enrolled in a rigorous observational cohort study with reliably obtained clinical data. We hypothesized that in this contemporary cohort, acculturation (defined by an individual's birthplace and proficiency in English) would be associated with increased frequency of APOs, specifically preterm birth (<37 weeks of gestation), preeclampsia or eclampsia, gestational diabetes, stillbirth, small for gestational age (birthweight <10% for gestational age), and large for gestational age (birthweight >90% for gestational age).[10]

METHODS

This is a planned secondary analysis of data from the Nulliparous Pregnancy Outcomes Study (nuMoM2b), a prospective observational cohort study of 10,038 nulliparous women with singleton gestations, who were recruited from 8 academic centers in the U.S. from October 2010 to September 2013. Detailed methodology for the study has been published previously.[24]

Briefly, women were approached for enrollment after sonographic confirmation of a viable, singleton pregnancy between 6 weeks, 0 days and 13 weeks, 6 days gestational age. Women were excluded from the study if they had a previous pregnancy that lasted at least 20 weeks of gestation or ended with the birth of a fetus weighing at least 360g. Additional exclusion criteria were maternal age less than 13 years, history of three or more spontaneous abortions, evidence of fetal malformation prior to enrollment, assisted reproduction with donor oocyte, multifetal reduction, plan to terminate the pregnancy, or participation in an intervention study that could affect either maternal or fetal outcomes.

Women participated in three study visits during pregnancy, and a final study visit at the time of delivery. At those visits, women were queried on a variety of topics, including their social lives and health history. In particular, women were asked about the language in which they felt most comfortable conducting the study visits (e.g. preference for English, Spanish, or other), as well as their perception of their English proficiency (e.g. "very well," "well," "not well," or "not at all"). After delivery, trained research staff abstracted medical history and birth outcomes from participants' medical records according to *a priori* study definitions by a trained chart abstractor. These data were subject to quality control checks.[24]

For the purposes of this analysis, we defined our exposure – acculturation – using a composite of birthplace of the participant (U.S. vs. non-U.S.), self-rated English proficiency, and preference for English or Spanish during the initial study visit. More acculturated participants were those born in the U.S. with a reported proficiency in English as "very well" or "well". Less acculturated participants were either born or not born in the U.S. and reported proficiency in English as "not well" or "not at all" or used Spanish as the preferred language during study visits. Of note, English and Spanish were the only two languages

employed during study visits, but individuals could participate in the study and be consented if their primary language was not English or Spanish, but they felt comfortable proceeding with the study visit in either of these two languages. Our definition of acculturation is in line with previous population-based definitions which do not use a standardized interview tool, and includes both nativity (e.g. born in or outside of the U.S.) and language preference as a proxy for cultural identification.[9]

The primary outcomes of our analysis include several APOs, each analyzed separately: preterm birth, defined as any live birth between 20 weeks and 0 days and 36 weeks and 6 days, with dates based on sonographically-confirmed gestational age prior to 14 weeks; small for gestational age, defined as birthweight less than 10% for gestational age; large for gestational age, defined as birthweight > 90% for gestational age;[25] and stillbirth, defined as birth of a dead fetus at greater than or equal to 20 weeks 0 days gestation. A priori, we subdivided preterm birth into spontaneous birth (due to onset of painful contractions or preterm rupture of membranes) or medically indicated birth (after induction of labor or cesarean delivery due to a medical or pregnancy-related comorbidity, such as placenta previa or fetal growth restriction). We also evaluated preeclampsia or eclampsia. Post-hoc, we divided preeclampsia or eclampsia into individual subtypes (e.g. preeclampsia with severe features and eclampsia or preeclampsia without severe features), inclusive of women with new onset hypertension as well as those with chronic hypertension, and added gestational hypertension as a separate outcome. These outcomes adhere to the American College of Obstetricians and Gynecologists' reVITALize Obstetric data definitions.[26]

All women in the cohort were included in this analysis unless they did not have information available to determine acculturation status. Univariable analyses were performed with either Chi-squared test or Fisher's exact test as appropriate. Multivariable logistic regression was used to adjust for potential confounding factors. Two authors (A.P. & M.P.D.) had constructed an ante-hoc directed acyclic graph in order to theorize the relationship between the degree of acculturation and APOs (Appendix 1, available online at http://links.lww.com/AOG/B699).[27] Directed acyclic graphs are visual representations of proposed causal pathways between the variables and indicators of interest, and therefore demonstrate mediating, moderating, or confounding variables within the pathway.[28] Constructing a directed acyclic graph *a priori* allows investigators to justify the choice of included covariates, and to avoid controlling for mediating or moderating variables that would introduce collider stratification bias and spurious results.[27]

Based on the directed acyclic graph, we created an initial multivariable model (model 1) that included the covariates of maternal age, gravidity, poverty, maternal self-reported race or ethnicity, educational level, and insurance payor (Model 1). Poverty was determined based on income for household size in relationship to the U.S. federal poverty level (FPL), and was defined as <100% of FPL. Maternal race or ethnicity is self-reported and categorized as non-Hispanic white, non-Hispanic black, Hispanic, or other. Maternal education is reported as less than high school, high school graduate, some college, Associate's or Technical degree, completed college, or degree work beyond college. Finally, maternal insurance status is categorized as government-based insurance, commercial health insurance, personal (or income)-based insurance, and military or other payor. These covariates were chosen based

on a literature review of acculturation and adverse health outcomes that suggested their potential role as confounding variables.

The initial model did not include body mass index (BMI), smoking, pregestational diabetes, and chronic hypertension as covariates, as our *a priori* hypothesis suggested that these variables may lie on the causal pathway between acculturation and APOs. However, we created a second model (Model 2) that added the aforementioned variables into the model in order to further probe this possibility.

Because a majority of studies evaluating acculturation and APOs focus on Hispanic and Latina populations, we utilized a Breslow-Day test of interaction to evaluate whether the associations between acculturation and APOs, specified *a priori*, differed by self-described maternal race or ethnicity.[2,3,5,11,12,15–17,19,20,23,29] A Breslow-Day test evaluates whether the odds ratios or relative risks generated by univariable analysis differ by strata of another variable. To evaluate these same relationships in the subgroup of women who are first- and second-generation immigrants (e.g. women who would be the most likely to undergo acculturation), a sub-analysis was performed for Model 1 which included only women born outside the U.S. and women born in the U.S. with one or more parents born outside of the U.S.[30,31] We used an alpha of 0.05 to define statistical significance. All analyses were performed using Stata 15.1 (College Station, TX) and are reported in adherence with the STROBE guidelines.[32] Institutional Review Board approval was obtained by all study centers (Northwestern STU#00030993).[24]

RESULTS

Of 10,038 women enrolled in the cohort, 32 were excluded due to lack of data to assess acculturation, leaving 10,006 for analysis. Eight thousand one hundred (80.9%) were classified as more acculturated, and 1,906 (19.1%) were classified as having less acculturation. The baseline characteristics of the participants are displayed in Table 1. Compared to women with less acculturation, more acculturated women were more likely to be between the ages of 13 and 21; to identify as non-Hispanic white or non-Hispanic black; and to have commercial payor insurance. On univariable analysis, there was a statistically higher frequency of women with more acculturation completing some college (20.0% v. 17.2%, $p = 0.007$) or Associate's or Technical degrees (10.3% v. 8.7%, $p = 0.031$); however, less acculturated women had a higher frequency of advanced degree work (21.6% v. 29.3%, $p < 0.001$).

Regarding chronic co-morbidities, less acculturated women had a lower frequency of pregestational diabetes, smoking, chronic hypertension, and obesity. Among women with less acculturation, the majority of women not born in the U.S. were from the Caribbean (n=330, 17.3%); Central and South America (n=313, 16.4%); and South and East Asia (n=260, 13.6%).

In univariable analyses, when compared to women with less acculturation, more acculturated women were more likely to have preterm birth (8.3% v. 5.8%, OR 1.46, 95% CI 1.18-1.81); spontaneous preterm birth (5.1% v. 3.4%, OR 1.54, 95% CI 1.18-2.01); preeclampsia or

eclampsia (8.8% v. 6.4%, OR 1.39, 95% CI 1.14-1.70); preeclampsia without severe features (4.6% v. 3.3%, OR 1.44, 95% CI 1.10-1.89); and gestational hypertension (14.9% v. 9.4%, OR 1.68, 95% CI 1.42-1.98). In addition, acculturated participants were less likely to have gestational diabetes (3.9% v. 5.8%, OR 0.66, 95% CI 0.52-0.83) (Tables 2–3). There were no differences in stillbirth, small for gestational age, or large for gestational age.

The results of the multivariable logistic regression models are presented in Table 3. After controlling for maternal age, gravidity, poverty, maternal race or ethnicity, educational level, and insurance payor (Model 1), more acculturation remained associated with an increased odds for preterm birth (aOR 1.50, 95% CI 1.16-1.95), spontaneous preterm birth (aOR 1.62, 95% CI 1.14-2.24); preeclampsia or eclampsia (aOR 1.31, 95% CI 1.03-1.67); preeclampsia without severe features (aOR 1.43, 95% CI 1.03-2.01); and gestational hypertension (aOR 1.48, 95% CI 1.22-1.79). After adjustment, the association between more acculturation and gestational diabetes was no longer statistically significant.

In Model 2, after additionally controlling for BMI, smoking, pregestational diabetes, and chronic hypertension, the point estimate of most odds ratios changed by less than 10%, and retained their direction of association (i.e., greater acculturation was associated with greater odds of APOs). The increased odds for preterm birth (aOR 1.37, 95% CI 1.05-1.80); spontaneous preterm birth (aOR 1.59, 95% CI 1.13-2.25); and gestational hypertension (aOR 1.39, 95% CI 1.14-1.69) among women with more acculturation continued to be significant, although the association with preeclampsia or eclampsia, as well as with preeclampsia without severe features, became non-significant, due to wider confidence intervals that included unity. Finally, the association of gestational diabetes became somewhat stronger in Model 2 and was statistically significant (aOR 0.73, 95% CI 0.55-0.98), as it had been in univariable analysis.

Breslow-Day tests of interaction revealed no differences in the association between acculturation and APOs by maternal race or ethnicity (p-values for interactions, all >0.05). That is, the relationship between acculturation and APOs is similar across racial or ethnic categories, with non-significant differences in the odds ratios for acculturation across racial and ethnic groups.

When limiting the data to only first- or second-generation immigrants (women born outside the U.S., or whose parent(s) were born outside the U.S.), more acculturated women continued to have higher odds of preterm birth (aOR 1.58, 95% CI 1.06-2.35); preeclampsia or eclampsia (aOR 1.49, 95% CI 1.02-2.16); and gestational hypertension (aOR 1.65, 95% CI 1.19-2.28), but did not have a significant increased odds of spontaneous preterm birth or preeclampsia without severe features (Appendices 2–4, available online at http://links.lww.com/AOG/B699). Breslow-Day tests once again demonstrated no difference in these associations by maternal racial or ethnic group.

DISCUSSION

We demonstrated that, after controlling for confounding variables, acculturation was associated with increased odds of a variety of APOs, including preterm birth; spontaneous

preterm birth; preeclampsia or eclampsia; preeclampsia without severe features; and gestational hypertension. A subgroup analysis that focused on first- or second-generation immigrants also showed that acculturation was associated with higher odds of preterm birth; preeclampsia or eclampsia; and gestational hypertension. We did not find a difference in frequency of the aforementioned APOs based on maternal race or ethnicity in the principal or subgroup analysis.

Racial and ethnic inequities in U.S. pregnancy outcomes stem from a complex interplay of sociocultural mechanisms; the relationship between immigration, health outcomes, and inequalities for both U.S.-born and foreign-born women of color may represent one piece of this puzzle. The “Latina immigrant paradox” is one prominent example, demonstrating that Latina women born outside the U.S. have fewer low birthweight infants than U.S.-born Latina women, and in fact have rates that approximate those of U.S.-born white women.[28,29,30] Social epidemiologists, demographers, and public health scientists employ the concept of acculturation – a theory advanced first in cultural anthropology – as one potential explanation of this phenomenon.[4,5,7,8,33–36] This theory posits that the extent to which women from migrant communities internalize or are incorporated into the cultural values and societal expectations of the U.S. may affect their pregnancy outcomes. Acculturation is a dynamic process, and its influence on health is multifactorial, incorporating individual, local, and trans-generational components.[6] For instance, maternal residence in an ethnic enclave (a neighborhood with relative ethnic isolation from surrounding communities) may modify the relationships between nativity and birth outcomes.[19,23,29]

Our results are consistent with previous population-based and ethnographic studies, which found a relationship between acculturation – as defined by nativity, facility with English, and preferred language – and APOs.[2,3,11–16] Our work does not test the Latina–immigrant paradox directly, as we did not compare recent migrants directly with women who identify as being from the same country or culture of origin, which is beyond the capability of these data. However, this work expands upon the relationship between acculturation and birth outcomes identified in other studies by providing reliable diagnoses of clinically relevant subsets of APOs. Clinical granularity to this level and reliability is rarely possible using vital records or administrative data; identifying spontaneous preterm birth and hypertensive disorders of pregnancy as particular risks for acculturated women may help to target risk reduction strategies or surveillance in the future.

Our evaluation of whether or not BMI, smoking, pregestational diabetes, and chronic hypertension could be considered confounding variables, rather than on the causal pathway between acculturation and APOs, suggests that the addition of these covariates did little to change the overall findings or directionality of the initial multivariable regression model (i.e. Model 1) that did not include these variables. These findings suggest that the aforementioned variables may not be significant mediators on the causal pathway between acculturation and APOs. However, this conclusion is strongly limited by our study design and analytic method. The mechanism that accounts for the role of acculturation with APOs continues to be uncertain and is in need of further investigation.

Though we did not find a difference in results based on maternal race or ethnicity, this is also consistent with other studies. Recently immigrated women of color tend to have improved pregnancy outcomes compared to either their second-generation (or more) ethno-cultural counterparts. This is true not only for Latina women, but also for women of African or Asian–Pacific Islander heritage.[20] Importantly, our data also expands the racial or ethnic group in question to women other than Latinas, who have most commonly been the focus of acculturation studies.[22]

We further interrogated the relationship between acculturation and APOs by evaluating only those women whose immigration or family history suggested they were most likely to become acculturated. In these analyses, our results were similar to the results of the full cohort, with acculturated women having increased odds of preterm birth, preeclampsia or eclampsia, and gestational hypertension. The fact that the odds for a spontaneous preterm birth or preeclampsia without severe features were no longer significantly increased among acculturated women in this sub-analysis is likely driven by lower power due to the smaller sample size, as suggested by similar point estimates but wider confidence intervals for odds ratios among subtypes of preterm birth and preeclampsia or eclampsia.

Strengths of this study include the large, prospectively collected sample of nulliparous women across the U.S. The accuracy of the outcomes described in the study are one of the main highlights, making it possible to reliably assess outcomes that have not been extensively evaluated in the past (e.g. preeclampsia or eclampsia) or outcomes that are more specific and reliable (e.g. spontaneous preterm birth, as opposed to all preterm birth). Therefore, the study is able to translate previous epidemiological findings into a clinically relevant context. Furthermore, the fact that our study reliably reproduces findings demonstrated in other studies of acculturation and adverse pregnancy outcomes highlights the external validity of our findings.[2,3,11–16] Finally, the accuracy of the self-reported baseline sociodemographic attributes of the sample population allows for the ability to create a framework for acculturation that attends to individual (e.g., place of birth) and context-specific (e.g. preference for English or Spanish for study interviews) dimensions, as well as a proxy for social interaction within the U.S. (e.g., English proficiency).

The study has important limitations, particularly surrounding the construction of the categories of acculturation. The purpose of incorporating a preference for the use of Spanish during study visits is to capture women born in the U.S. who may live in ethnically- or linguistically-isolated neighborhoods in which Spanish is routinely spoken. Because English and Spanish were the only languages used in the study visits, we cannot postulate as to whether or not similar results would be found among women who employ other languages. Furthermore, we cannot assess how prenatal care may have proceeded based on language preference of the participants.

A validated survey or ethnographic assessment of acculturation was not part of the ongoing prospective study, and thus we defined acculturation utilizing available data. Importantly, because of this limitation, we were unable to characterize acculturation using a multidimensional framework (e.g. changes in acculturation status over time, interpersonal relationships outside of the immediate family and partner, educational opportunities afforded

by migration).[4,6,8] While validated instruments to assess acculturation exist, large population studies commonly use such features as language preference, English proficiency, and location of birth to determine acculturation.[10] Notably, 38.7% of the less acculturated cohort was made up of women of Hispanic background, in contrast to 11.6% of the more acculturated cohort. Such an imbalance could have important consequences for our findings, though we were unable to demonstrate a racial or ethnic difference in the association of acculturation with APOs.

Length of residence in the U.S. has been demonstrated in other studies to be associated with preterm birth risk.[37,38] While birthplace of participants in the study was accurately reported in our data, the length of residency within the U.S. could not be reliably assessed; if available, this could improve the nuance in our definition of acculturation. Due to the number of covariates controlled for during multivariable regression analysis and the rarity of outcomes like medically-indicated preterm birth and stillbirth, our findings in those domains may reflect an overfitted model. Finally, we acknowledge that the magnitude of aORs in this analysis are less than 2, which critics of observational cohort analyses would generally consider a weak signal.[39,40] However, it is also important to note that this is frequently the case with observational studies in which social determinants of health are the primary exposure. The analyses we report contribute further evidence of reproducibility in a body of literature that suggests acculturation is associated with APOs. The nature of how APOs were clinically and reliably ascertained in this study provides a unique opportunity to develop hypotheses to study these associations specifically.

In conclusion, among a diverse group of nulliparous women with singleton pregnancies, women with more acculturation have higher odds of preterm birth; spontaneous preterm birth; preeclampsia or eclampsia; preeclampsia without severe features; and gestational hypertension compared to less acculturated women. These findings did not differ by maternal race or ethnicity. Further studies should be performed to prospectively assess the multidimensional aspects of acculturation and specific perinatal outcomes.[4,8,9]

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Authors' Data Sharing Statement

Will individual participant data be available (including data dictionaries)? *No.*

What data in particular will be shared? *Not available.*

What other documents will be available? *Not available.*

When will data be available (start and end dates)? *Not applicable.*

By what access criteria will data be shared (including with whom, for what types of analyses, and by what mechanism)? *Not applicable.*

Table 1.

Demographic characteristics by acculturation status[a]

Demographics	*More acculturated*[b] *(n=8100)*	*Less acculturated*[c] *(n=1906)*	p value[d]
Maternal Age			
13-21	1818 (22.4)	309 (14.4)	<0.001
22-34	5616 (69.3)	1332 (69.9)	
35-41	666 (8.2)	265 (13.9)	
Gravidity			
1	6044 (74.6)	1383 (72.6)	0.065
2 or more	2056 (25.4)	523 (27.4)	
Poverty			
>200% FPL[e]	4632 (69.8)	1029 (69.2)	0.644
100-200% FPL	958 (14.4)	210 (14.1)	
<100% FPL	1046 (15.8)	249 (16.7)	
Race or ethnicity			
Non-Hispanic white	5316 (65.6)	672 (35.3)	<0.001
Non-Hispanic black	1275 (15.7)	142 (7.4)	
Hispanic	942 (11.6)	737 (38.7)	
Other	567 (7.0)	355 (18.6)	
Education			
Less than high school	669 (8.2)	146 (7.7)	<0.001
High school graduate	953 (11.8)	210 (11.0)	
Some college	1616 (20.0)	327 (17.2)	
Technical or Associate's	837 (10.3)	165 (8.7)	
Completed College	2276 (28.1)	495 (26.1)	
Advanced degree work	1749 (21.6)	557 (29.3)	
Insurance			
Government-based	2078 (25.8)	614 (32.4)	<0.001
Military or unspecified	135 (1.7)	52 (2.7)	
Commercial	4466 (55.5)	882 (46.5)	
Personal or individual	1363 (17.0)	348 (18.4)	
Pregestational diabetes	132 (1.7)	19 (1.1)	0.046
Smoking[e]	560 (6.9)	31 (1.6)	<0.001
Chronic hypertension	220 (2.9)	23 (1.3)	<0.001
Obesity (Body Mass Index ≥ 30 kg per m^2)	1910 (23.6)	258 (13.5)	<0.001

Abbreviations: FPL – Federal Poverty Level;

[a]Data presented as n, % by column unless otherwise indicated. Not all columns add to total sample size due to missing values

[b]Subjects born in the U.S. who reported proficiency in English

[c] Subjects born or not born in the U.S. who reported limited or poor proficiency in English or preferred study visits conducted in Spanish

[d] χ^2 or Fisher's exact tests

[e] Maternal report in prior month at intake visit

Table 2.

Adverse pregnancy outcomes by acculturation status[a]

Adverse pregnancy outcomes	*More acculturated*[b] *(n=8100)*	*Less acculturated*[c] *(n=1906)*	p value[d]
All preterm birth (PTB)			
Yes	672 (8.3)	111 (5.8)	<0.001
No	7428 (91.7)	1795 (94.2)	
Spontaneous PTB			
Yes	411 (5.1)	64 (3.4)	0.002
No	7689 (94.9)	1842 (96.6)	
Indicated PTB			
Yes	261 (3.2)	47 (2.5)	0.085
No	7839 (96.8)	1859 (97.5)	
Preeclampsia or eclampsia			
Yes	710 (8.8)	123 (6.4)	0.001
No	7390 (91.2)	1783 (93.6)	
Preeclampsia with severe features or eclampsia			
Yes	336 (4.2)	61 (3.2)	0.057
No	7764 (95.8)	1845 (96.8)	
Preeclampsia without severe features			
Yes	374 (4.6)	62 (3.3)	0.009
No	7726 (95.4)	1844 (96.7)	
Gestational hypertension[e]			
Yes	1176 (14.9)	178 (9.4)	<0.001
No	6704 (85.1)	1705 (90.6)	
Stillbirth			
Yes	123 (1.5)	18 (0.9)	0.065
No	7977 (98.5)	1888 (99.1)	
Gestational diabetes[f]			
Yes	292 (3.9)	102 (5.8)	<0.001
No	7241 (96.1)	1665 (94.2)	
Small for gestational age			
Yes	722 (8.9)	186 (9.8)	0.248
No	7378 (91.1)	1720 (90.3)	
Large for gestational age			
Yes	474 (5.9)	129 (6.8)	0.130
No	7626 (94.1)	1777 (93.2)	

[a]Data presented as n, % by column unless otherwise noted. Not all columns add to total sample size due to missing values

[b]Subjects born in the U.S. who reported proficiency in English

[c] Subjects born or not born in the U.S. who reported limited or poor proficiency in English or preferred study visits conducted in Spanish

[d] χ^2 or Fisher's exact tests

[e] Excluding women with chronic hypertension

[f] Excluding women with pre-gestational diabetes

Table 3.

Association between acculturation and adverse pregnancy outcomes

	Unadjusted		*Model 1*[a]		*Model 2*[b]	
Outcome	**OR**	**95% CI**	**aOR**	**95% CI**	**aOR**[a]	**95% CI**
All preterm birth (PTB)	1.46	1.18-1.81	1.50	1.16-1.95	1.37	1.05-1.80
Spontaneous PTB	1.54	1.18-2.01	1.62	1.14-2.24	1.59	1.13-2.25
Indicated PTB	1.32	0.96-1.80	1.32	0.88-1.98	1.05	0.69-1.58
Preeclampsia or eclampsia	1.39	1.14-1.70	1.31	1.03-1.67	1.18	0.92-1.51
Preeclampsia with severe features or eclampsia	1.31	0.99-1.72	1.16	0.83-1.62	1.10	0.79-1.55
Preeclampsia without severe features	1.44	1.10-1.89	1.43	1.03-2.01	1.25	0.89-1.76
Gestational hypertension[c]	1.68	1.42-1.98	1.48	1.22-1.79	1.39	1.14-1.69
Stillbirth	1.62	0.98-2.66	1.71	0.94-3.11	1.05	0.38-2.95
Gestational diabetes[d]	0.66	0.52-0.83	0.88	0.66-1.17	0.73	0.55-0.98
Small for gestational age	0.90	0.76-1.07	0.94	0.76-1.17	0.94	0.75-1.17
Large for gestational age	0.86	0.70-1.05	0.96	0.75-1.23	0.96	0.76-1.21

[a]Adjusted for age, gravidity, poverty, race or ethnicity, education, and insurance

[b]Adjusted for age, gravidity, poverty, race or ethnicity, education, insurance, BMI, smoking, pregestational diabetes, and chronic hypertension

[c]Excluding women with chronic hypertension

[d]Excluding women with pre-gestational diabetes