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Racial/Ethnic Differences in the Prevalence of Gestational Diabetes Mellitus and Maternal Overweight and Obesity, by Nativity, Florida, 2004–2007

Shin Y. Kim[1], **William Sappenfield**[2], **Andrea J. Sharma**[1], **Hoyt G. Wilson**[1], **Connie L. Bish**[1], **Hamisu M. Salihu**[3], and **Lucinda J. England**[1]

[1]Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

[2]Division of Family Health Services, Florida Department of Health, Tallahassee, Florida, USA

[3]Department of Biostatistics and Epidemiology, University of South Florida, Tampa, Florida, USA

Abstract

Objective—We examined the risk of gestational diabetes mellitus (GDM) among foreign-born and U.S.-born mothers by race/ethnicity and BMI category.

Design and Method—We used 2004–2007 linked birth certificate and maternal hospital discharge data of live, singleton deliveries in Florida to compare GDM risk among foreign-born and U.S.-born mothers by race/ ethnicity and BMI category. We examined maternal BMI and controlled for maternal age, parity, and height.

Results—Overall, 22.4% of the women in our study were foreign born. The relative risk (RR) of GDM among women who were overweight or obese (BMI ≥ 25.0 kg m^{-2}) was higher than among women with normal BMI (18.5–24.9 kg m^{-2}) regardless of nativity, ranging from 1.3 (95% confidence interval (CI) = 1.0, 1.9) to 3.8 (95% CI = 2.1, 7.2). Foreign-born women also had a higher GDM risk than U.S.-born women, with RR ranging from 1.1 (95% CI = 1.1, 1.2) to 2.1 (95% CI = 1.4, 3.1). This finding was independent of BMI, age, parity, and height for all racial/ ethnicity groups.

Conclusions—Although we found differences in age, parity, and height by nativity, these differences did not substantially reduce the increased risk of GDM among foreign-born mothers. Health practitioners should be aware of and have a better understanding of how race/ethnicity and nativity can affect women with a high risk of GDM. Although BMI is a major risk factor for GDM, it does not appear to be associated with race/ethnicity or nativity.

Correspondence: Shin Kim (skim1@cdc.gov).

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Introduction

Gestational diabetes mellitus (GDM) is defined as carbohydrate intolerance that leads to hyperglycemia with onset or first recognition of pregnancy. It is associated with increased risk of complications during pregnancy and delivery, including cesarean section, infant macrosomia and associated maternal and infant trauma, and neonatal hypoglycemia (1–4). Prevalence estimates for GDM range from 3 to 6% of all pregnancies, depending on the population studied and the diagnostic tests employed (5–8).

Recent estimates indicate that nearly one in two women in the United States begins pregnancy overweight or obese (9), and pre-pregnancy overweight and obesity are strong risk factors for GDM. Women who are overweight, obese, or severely obese before pregnancy, are two, four, and eight times more likely to develop GDM, respectively, compared with normal weight women (10). Women who are Asian (particularly South Central Asian), American Indian, or Hispanic have the highest risk of developing GDM (11–15), and differences in GDM risk across racial/ethnic groups do not appear to be fully explained by differences in prepregnancy BMI (16–18). In fact, foreign-born women are less likely to be overweight or obese than U.S.-born women, although the proportion of foreign-born women who are overweight or obesity increases with longer duration of residence in the United Sates (19,20). The latter finding may be due to changes in diet and the level of physical activity that result from acculturation (21).

The U.S. immigrant population has increased fourfold over the last four decades, and 39 million immigrants accounted for 12.9% of the total U.S. population in 2010 (22). In general, foreign-born women have healthier pregnancy outcomes than U.S.-born women because they typically have lower maternal BMI, lower blood pressure, and fewer adverse risk behaviors (23). Paradoxically, data have shown that foreign-born women have a higher risk of developing GDM than U.S.-born women (13,15,24). However, this finding has not been consistently shown in the general diabetes population (25,26). It has been suggested that a woman's early life environment may influence her risk of metabolic diseases such as diabetes later in life (27). While there is evidence that the risk of developing GDM differs by race/ethnicity, little data are available examining whether a woman's nativity is associated with GDM independent of BMI status. Thus, we examined the risk of GDM among foreign-born and U.S.-born mothers by race/ethnicity and BMI category.

Methods and Procedures

We analyzed live, singleton deliveries occurring from March 2004 through December 2007 in Florida. We used the state's revised live birth certificates, which incorporate parts of the 2003 U.S. Standard Certificate of Live Birth and are linked to the state's Hospital Inpatient Discharge Database. Live, singleton birth records were linked to maternal inpatient hospitalizations through a multistage, stepwise approach that used the mother's social security number as the primary linking variable. Records without a social security number were excluded (11.5%). Maternal delivery hospital discharge and birth certificate records were cleaned, and linking variables were standardized and formatted before data linkage. Date of delivery, facility of birth, infant sex, and mother's residential zip code were used to improve the accuracy of the links. All institutions in Florida, except for military and Veterans Administration institutions, are represented. Approximately 97.6% of live, singleton deliveries with known maternal social security numbers were successfully linked.

Maternal characteristics

We used Florida's live birth certificate to obtain data on maternal characteristics such as age, educational attainment, marital status, race/ethnicity, insurance status, parity, smoking status, birth country, prepregnancy weight and height, diabetes in pregnancy, and enrollment in the Special Supplemental Nutrition Program for Women, Infant, and Children. Maternal race categories on Florida's birth certificate are white, black or African American, American Indian or Alaska Native, Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, other Asian, Native Hawaiian, Guamanian or Chamorro, Samoan, other Pacific Islander, and other. Maternal Hispanic and Haitian origin are collected separately; Hispanic subcategories are Mexican, Central/South American, Puerto Rican, Cuban, or other. For our analysis, we grouped maternal race/ethnicity into 11 categories: non-Hispanic white, non-Hispanic black, Asian Indian, Vietnamese, East Asian (Chinese, Korean, and Japanese), Filipina, Mexican, Cuban, Central/South American, other Hispanic, and Haitian. We excluded Puerto Rican, Guamanian or Chamorro, and Samoan mothers because women in these groups may have been born in U.S. territories, and it was not clear how they would report their nativity. We excluded American Indian/Alaska Native, Native Hawaiian, and other Pacific Islander mothers because of small sample sizes. We also excluded mothers who indicated more than one racial group.

Prepregnancy BMI (maternal weight in kilograms/height in meter) was calculated from the height and prepregnancy weight variables on the birth certificate. For our main analysis, we used the National Heart, Lung, and Blood Institute's categories (28) to classify women as normal weight (BMI 18.5–24.9 kg m^{-2}), overweight (BMI 25.0–29.9 kg m^{-2}), class I obese (BMI 30.0–34.9 kg m^{-2}), class II obese (BMI 35–39.9 kg m^{-2}), or class III obese (BMI $\geq$ 40.0 kg m^{-2}). In addition, because people of Asian descent are at elevated risk of diabetes and cardiovascular disease at lower BMI values than people of European descent (29), we used the following categories from the World Health Organization (WHO) (30) for a subanalysis of Asian and Filipina women: underweight (BMI <18.5 kg m^{-2}), normal weight (BMI 18.5–22.9 kg m^{-2}), overweight I (BMI 23–24.9 kg m^{-2}), overweight II (BMI 25–29.9 kg m^{-2}), and obese (BMI >30 kg m^{-2}).

Diabetes status in pregnancy was determined by using data from birth certificates and hospital discharge records. The diabetes variable on the birth certificate is separated into prepregnancy (diagnosis before this pregnancy) and gestational (diagnosis during this pregnancy), and only one selection is allowed. If both options are marked, the record is sent back to the birth facility for corrections. There is also a "none" option if neither diagnosis applies. In the Florida hospital discharge records, diabetes during pregnancy is identified by the following International Classification of Diseases, 9th Revision, Clinical Modification (ICD9-CM) codes: 648.8 (abnormal glucose tolerance (gestational diabetes)) or 648.0 or 250.0–250.9 (diabetes mellitus (excludes gestational diabetes)).

Statistical analysis

We used data from a medical record review of a small subset of the pregnancies in our linked dataset from a previous study to formulate rules for assigning GDM status. GDM cases were defined as deliveries in which hospital discharge data included the ICD9-CM code for gestational diabetes (648.8), except in instances in which the birth certificate indicated preexisting diabetes. Pregnancies without diabetes were those for which both the hospital discharge and birth certificate records indicated no diabetes (neither preexisting nor gestational). All other pregnancies were excluded from our analysis (2.3%). Excluded pregnancies included any deliveries where hospital discharge records indicated preexisting diabetes, where the birth certificate indicated some form of diabetes but the hospital discharge record indicated no diabetes, where hospital discharge records indicated both preexisting and gestational diabetes, or where the diabetes status from the birth certificate was missing. We estimated that our classification methods had a sensitivity and specificity of 55.8 and 99.9%, respectively, in identifying women who had GDM and those who had no diabetes. We calculated bias on the basis of projections from the medical records sample, which indicated that GDM misclassifications in this dataset would cause us to underestimate GDM prevalence by 44%, but to underestimate relative risk (RR) by only about 5% (assuming nondifferential misclassification).

Starting with all linked deliveries to mothers in one of our 11 racial/ ethnic groups, we excluded the following pregnancies from our analysis: those with missing values of mother’s nativity or prepregnancy BMI, those with implausible maternal height (<4′2″ or >6′5″) or weight (<75 pounds), and those that our diabetes status classification rules did not classify as either “GDM” or “No diabetes.” After exclusions, our final dataset included 91.5% of all linked deliveries in the racial/ethnic groups of interest.

We examined maternal demographic and behavioral characteristics overall and by maternal race/ethnicity by nativity. We selected potential confounders for inclusion in the logistic models on the basis of the amount by which the inclusion of the variable changed the adjusted odds ratio and on a review of relevant literature. Because we observed evidence of confounding by age in some racial groups, we included age as a covariate in our final adjusted models. While we found little evidence of confounding (i.e., changing odds ratio (OR) by >10%) by other maternal characteristics, we included parity because it has been found to be independently associated with both BMI and GDM in previous studies. In addition, we included height in the models because short stature has been associated with adverse health outcomes. In tests of interaction terms, we used a t-test for difference in logistic regression coefficients between models to determine whether nativity is a modifier of the relationship between GDM and BMI and a likelihood ratio test to determine whether BMI is a modifier of the relationship between GDM and nativity (31). We used the results of the logistic regression to compute RRs and their confidence intervals (CIs) according to methods described by Flanders and Rhodes (32).

Results

Maternal characteristics by race/ethnicity and nativity are presented in Table 1. Overall, 24.2% of live, singleton deliveries in Florida during 2004–2007 were to foreign-born women; after exclusions, 22.4% of the deliveries in our analysis sample were to foreign-born women. U.S.-born women were younger and more likely to be nulliparous than foreign-born women. In addition, in all racial/ethnic groups except Haitians and non-Hispanic blacks, U.S.-born women had a higher mean height than foreign-born women (Table 1). These differences ranged from 0.1 to 1.0 in., and all differences were statistically significant, except those for East Asian women (data not shown).

The absolute risk of GDM was higher among mothers who were overweight or obese (BMI ≥25 kg m^{-2}) for both U.S.-born and foreign-born women in all race/ethnicity groups (Table 2). For U.S.-born women, the RR of GDM for mothers who were overweight or obese (BMI ≥ 25 kg m^{-2}) ranged from 1.6 (95% CI = 0.5, 5.2) among Vietnamese women to 3.8 (95% CI = 2.1, 7.2) among Haitian women. For foreign-born women, the RR ranged from 1.3 (95% CI = 1.0, 1.9) among Vietnamese women to 2.5 (95% CI = 2.2, 2.8) among non-Hispanic white women (Table 2). When examined by individual racial/ethnic groups, differences in RR associated with BMI ≥25 kg m^{-2} between U.S.-born and foreign-born women were significant for Mexican women ($P = 0.02$) and non-Hispanic black women ($P = 0.02$). When examined by combined groups, differences were significant for the combined Asian/Filipina group ($P = 0.03$) and the combined Hispanic group ($P < 0.01$). In a subanalysis of Asian and Filipina women using the Asian WHO's BMI categories for Asians, results were similar when we compared women with normal weight (BMI 18.5–22.9 kg $^{-2}$) with those who were overweight or obese (BMI ≥ 23 kg m^{-2}) (data not shown).

When we compared foreign-born women with U.S.-born women by race/ethnicity, we found that foreign-born women were at higher risk of developing GDM than U.S.-born women, independent of BMI, age, parity, or height. The differences for all groups except Vietnamese and East Asian women were significant (Table 3). We also examined the coefficient of mother's height and found that all coefficients were negative, corresponding to ORs ranging from 0.92 to 0.99, which indicated that after adjusting for BMI, being taller is slightly protective against GDM. The differences for all groups except Vietnamese, East Asian, and Haitian women were significant (data not shown). We did not find a significant interaction when we examined BMI as a modifier of the relationship between GDM and nativity for individual racial/ethnic groups.

Discussion

In our analysis, we found that the risk of developing GDM was higher for women who were overweight or obese (BMI ≥ 25 kg m^{-2}) regardless of nativity. However, foreign-born women were at higher risk of GDM than U.S.-born women, and this relationship was independent of BMI, age, parity, and height for all racial/ethnic groups in our study sample. Although we saw absolute differences in age, parity, and height by nativity, these differences did not substantially attenuate the increased risk of GDM among foreign-born over U.S.-born mothers.

The increased risk of GDM among foreign-born women compared with U.S.-born women runs counter to what is expected considering the differences in obesity prevalence by nativity. However, our findings are consistent with previous studies examining GDM by race/ ethnicity and nativity (13,15,24). These studies all found that, for most racial/ethnic groups, foreign-born women (except Japanese and Korean women) consistently had a higher risk of GDM than U.S.-born women. In addition, Savitz et al. found that the risk of GDM increased over time for foreign-born South Central Asians, some Hispanics, and African Americans. While two of these studies adjusted for prepregnancy weight or weight during pregnancy (15,24), none specifically examined the role of BMI or height in the association between GDM and nativity.

Our findings have several possible explanations. Some women born outside of the United States may have come from communities with limited resources, including an adequate supply of nutritious food. This possibility is supported by our observation that most foreign-born women in our sample were, on average, shorter than U.S.-born women. Studies have shown that early life environmental factors that result in short stature as an adult may increase the risk of cardiovascular disease, diabetes, and obesity later in life (33,34). These factors may affect a person's insulin sensitivity and beta cell function or lead to the development of central adiposity when the person later experiences an obesogenic environment. Several studies also have shown that immigration to a western country is associated with changes in dietary and physical activity patterns (21). For example, foreign-born, low-income, postpartum women who had lived in the United States for 4 or fewer years ate 2.5 times more fruit and vegetable servings daily than U.S.-born, low-income women; this difference diminished with longer U.S. residence (35). In addition, foreign-born women are more likely to be physically inactive than U.S.-born adults, which may be due to cultural barriers, urban/rural residence, employment opportunities, and socioeconomic status (36). Changes in dietary and physical activity patterns may carry more risk for foreign-born women, some of whom may be predisposed to certain chronic disease conditions.

Although our study found that the RR of GDM associated with being foreign-born was independent of obesity, we know that clear differences in body fat distribution exist for members of different racial and ethnicity groups, and that BMI is not a perfect measure of body fat or central adiposity. Members of some ethnic groups, such as Hispanics and Asians, are more prone to develop abdominal obesity, and differences in fat distribution are considered a major contributor to observed excessive prevalence of insulin resistance and diabetes among some racial and ethnic groups (37). Researchers have hypothesized that adults with short stature are more prone to central adiposity, which has been linked to dyslipidemia, dysglycemia, and vascular disease (38,39). In addition, studies have shown that short stature is an independent risk factor for GDM (40). Some foreign-born women may develop more central adiposity from exposure to an obesogenic environment, which increases their risk of GDM, even though their overall BMI remains low. The addition of height in our models only slightly reduced these associations, and no measures of central adiposity were available. However, to our knowledge, no studies have examined differences in body fat distribution by nativity; therefore, future studies should examine the role of nativity and body fat distribution by race/ethnicity.

Our study has several limitations. Prepregnancy weight and height were obtained from birth certificates, and the origins of these variables are unknown. Some of this information may have come from measurements obtained in clinical settings, while some of it may have been self-reported. Estimates of obesity prevalence based on self-reported height and weight tend to be lower than those based on measured height and weight. In addition, we did not calculate gender-age-specific BMI for women <20 years of age. Therefore, we may have misclassified overweight and obesity for some adolescents, however excluding them would not have changed our RRs in our sample population. Second, we may have underestimated GDM prevalence. However, if we assume that no important variation in misclassification by BMI category occurred, our analysis suggests that our RR estimates are biased only slightly toward the null. Because the American College of Obstetricians and Gynecologists recommends universal GDM screening, we do not have any reason to believe that there is substantial bias in GDM diagnosis in the state of Florida. Ascertainment bias in GDM cases obtained by hospital staff for hospital discharge records or birth certificate records by BMI seems unlikely. Third, we were unable to link ∼11.5% of birth certificate records with hospital discharge records because maternal social security numbers were missing. The excluded records are more likely to have included undocumented immigrants. Thus, our results may not present a complete picture of the GDM risk among foreign-born women. Fourth, we did not have information on the duration of U.S. residence of the women in our sample, which limited our ability to understand the effect of acculturation on a woman's risk of GDM. Finally, our data may not be generalizable to women in states other than Florida. However, because Florida is the fourth most populous U.S. state and has a high level of racial/ ethnic diversity, it is a good source of data for studying racial/ethnic variations in the U.S. population.

Our study found that having elevated prepregnancy BMI and being foreign born contributed substantially to the risk of developing GDM risk for women in all racial/ethnic groups. Because the immigrant population in the United States is continuing to grow, studies that examine the racial and ethnic differences in the underlying pathophysiology of maternal diabetes are needed to help us better understand the mechanisms involved in the development of this disease. This information can in turn help us prevent GDM and obesity in foreign-born populations. Although overweight and obesity appear to be the strongest modifiable predictors of GDM, we need a better understanding of how race/ethnicity and nativity affect a woman's risk of developing GDM.

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TABLE 1

Maternal demographics, by mother's ethnicity and nativity, (%)[a]

Maternal	Total		Asian Indian		Vietnamese		East Asian[b]		Filipina		Mexican	
Characteristic	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**
N	463,136	133,552	459	3,947	169	2,692	377	2,874	568	2,900	12,810	9,575
Mother's age (years)												
<20	12.5	4.0	6.3	0.6	15.4	1.3	2.9	0.7	6.0	1.7	26.4	9.5
20–34	75.0	74.3	83.2	83.0	83.4	76.6	79.6	69.0	81.5	68.0	68.6	73.7
≥35	12.5	21.7	10.5	16.4	1.2	22.1	17.5	30.4	12.5	30.3	4.9	16.9
N missing	8	10	0	0	0	0	0	1	0	0	1	0
Mother's education (years)												
<12	17.0	15.6	5.7	3.5	11.8	21.3	2.9	6.6	5.3	3.2	42.2	55.8
12	32.3	31.3	15.7	10.8	27.2	34.1	12.2	19.2	14.6	14.0	34.0	26.8
>12	50.7	53.1	78.6	85.6	60.9	44.7	84.9	74.2	80.1	82.8	23.7	17.5
N missing	1,392	1,135	1	19	0	27	0	11	0	5	16	24
Mother married												
Yes	55.1	68.7	79.1	96.1	60.4	77.1	82.0	89.5	73.6	85.9	44.9	62.4
No	44.9	31.3	20.9	3.9	39.6	22.9	18.0	10.5	26.4	14.1	55.1	37.6
N missing	10	4	0	0	0	0	0	0	0	0	0	1
Insurance status												
Medicaid	46.4	37.8	25.7	14.5	52.7	38.5	16.2	18.8	22.6	13.8	68.2	46.5
Private	49.7	49.9	71.7	77.6	42.6	48.2	80.4	68.4	72.1	79.0	25.1	25.4
None	2.7	10.7	2.4	7.0	4.7	12.1	2.7	10.6	2.6	4.2	4.8	24.9
Other	1.2	1.6	0.2	0.9	0.0	1.2	0.8	2.2	2.6	3.0	1.9	3.2
N missing	1,107	627	3	20	0	14	0	19	1	1	22	41
WIC status												
Yes	41.8	42.4	20.1	13.7	48.5	28.9	12.1	17.4	22.2	17.9	64.4	64.3
No	58.2	57.6	79.9	86.3	51.5	71.1	87.9	82.6	77.8	82.1	35.6	35.7
N missing	4,297	1,799	16	84	0	79	4	36	6	25	68	72
Parity												
0	43.6	41.0	50.8	45.8	58.6	43.5	52.0	49.6	49.0	43.1	39.3	28.4

Maternal	Total		Asian Indian		Vietnamese		East Asian[b]		Filipina		Mexican	
Characteristic	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**
1–2	47.1	50.5	45.1	50.4	37.9	50.9	44.0	47.6	46.6	50.6	46.2	51.7
>2	9.3	8.5	4.1	3.8	3.6	5.5	4.0	2.8	4.4	6.2	14.5	19.9
N missing	2,113	763	0	12	0	5	0	8	1	3	11	14
Smoking												
Yes	10.9	1.2	2.4	0.4	5.4	0.6	3.3	1.8	2.5	1.3	3.7	0.5
No	89.1	98.8	97.6	99.6	94.6	99.4	96.7	98.2	97.5	98.7	96.3	99.5
N missing	12,173	753	7	5	2	8	8	28	16	16	217	21
Height in inches (mean)	64.7	63.8	63.5	63.1	62.7	61.6	63.4	63.3	62.7	61.9	62.9	62.3
Body mass index[c] (kg/m^2)												
<18.5	5.5	5.1	8.9	7.7	13.6	19.7	8.8	15.6	4.4	9.1	3.9	2.9
18.5–24.9	50.7	55.2	63.8	61.9	66.3	71.8	68.2	71.7	61.4	69.2	42.3	46.8
25–29.9	22.9	25.3	17.0	23.0	16.0	7.1	15.6	10.5	23.8	17.0	25.4	30.2
30–34.9	11.8	9.9	7.2	6.0	3.6	1.4	5.8	1.8	7.0	3.7	16.0	13.3
35–39.9	5.4	3.1	2.2	1.1	0.6	0.0	1.3	0.3	2.3	0.7	7.1	4.8
≥ 40	3.7	1.3	0.9	0.4	0.0	0.0	0.3	0.1	1.1	0.3	5.3	2.0
GDM[c]												
Yes	4.3	6.0	5.4	12.2	7.1	10.1	6.1	8.2	6.0	11.2	4.5	8.1
No	95.7	94.0	94.6	87.8	92.9	89.9	93.9	91.8	94.0	88.8	95.5	91.9

	Cuban		Central/S, American		Other Hispanic		Non-Hisp White		Non-Hisp Black		Haitian	
Characteristic	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**
N	14,375	19,703	8,208	33,714	5,892	8,332	310,915	19,934	106,807	13,909	2,556	15,972
Mother's age (years)												
<20	10.4	4.9	15.8	3.8	16.6	4.0	9.1	2.2	20.6	5.2	21.0	3.9
20–34	77.4	75.1	74.4	74.1	75.0	77.3	75.7	72.1	73.2	74.2	75.6	75.0
≥35	12.2	20.0	9.9	22.1	8.4	18.6	15.2	25.7	6.2	20.6	3.4	21.1
N missing	3	4	0	4	0	1	4	0	0	0	0	0
Mother's education (years)												
<12	10.9	10.4	13.0	13.8	16.4	12.3	13.6	5.0	25.3	10.1	16.1	27.9

Maternal	Total		Asian Indian		Vietnamese		East Asian[b]		Filipina		Mexican	
Characteristic	U.S.	FB	U.S.	FB	U.S.	FB	U.S.	FB	U.S.	FB	U.S.	FB
12	26.0	46.4	28.9	29.9	29.0	30.9	29.3	22.9	42.3	32.9	31.5	37.7
>12	63.1	43.2	58.1	56.3	54.6	56.8	57.1	72.1	32.4	57.0	52.4	34.4
N missing	20	46	19	230	18	85	721	92	583	269	14	327
Mother married												
Yes	66.1	58.5	57.3	71.3	52.3	70.6	66.3	84.6	22.5	51.4	33.7	58.3
No	33.9	41.5	42.7	28.7	47.7	29.4	33.7	15.4	77.5	48.6	66.3	41.7
N missing	0	0	0	2	0	0	7	1	2	0	1	0
Insurance status												
Medicaid	33.2	54.9	43.7	32.0	49.9	38.6	37.5	21.6	71.4	44.0	68.7	51.8
Private	65.0	40.9	53.1	53.8	46.1	51.5	58.3	68.7	25.8	47.2	27.5	30.4
None	1.4	3.6	2.7	12.6	2.9	8.5	2.9	8.3	1.9	7.4	3.5	15.5
Other	0.3	0.5	0.5	1.6	1.1	1.4	1.3	1.5	0.9	1.4	0.4	2.3
N missing	21	48	14	139	12	36	745	83	282	104	7	122
WIC status												
Yes	28.8	50.6	39.9	38.4	47.5	40.4	32.9	18.7	66.6	48.2	65.1	71.4
No	71.2	49.4	60.1	61.6	52.5	59.6	67.1	81.3	33.4	51.8	34.9	28.6
N missing	85	190	45	333	61	132	2,695	232	1,300	246	17	370
Parity												
0	48.7	45.9	52.0	42.7	49.8	39.3	44.8	45.6	38.5	37.3	54.8	34.1
1–2	46.8	51.1	43.3	51.0	43.7	53.2	48.0	48.2	45.4	50.0	40.0	49.9
>2	4.5	3.0	4.7	6.3	6.6	7.5	7.2	6.2	16.1	12.6	5.2	16.1
N missing	34	70	17	191	4	30	562	69	1,470	195	14	166
Smoking												
Yes	2.0	0.7	1.5	0.5	4.0	1.0	14.2	4.8	4.8	0.7	1.0	0.3
No	98.0	99.3	98.5	99.5	96.0	99.0	85.8	95.2	95.2	99.3	99.0	99.7
N missing	155	107	104	151	104	49	9,968	277	1,577	59	15	32
Height in inches (mean)	64.0	63.7	63.6	63.4	63.8	63.7	64.8	64.4	64.8	64.9	64.7	65.0
BMI[c] (kg/m^2)												
<18.5	3.4	4.5	3.7	3.9	4.9	5.3	6.0	6.4	4.6	3.9	3.6	3.1
18.5–24.9	52.0	53.1	53.3	59.0	50.2	58.4	54.3	63.6	40.8	45.4	44.8	41.5

Maternal	Total		Asian Indian		Vietnamese		East Asian[b]		Filipina		Mexican	
Characteristic	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**	**U.S.**	**FB**
25–29.9	24.4	27.4	25.9	24.8	24.5	24.1	21.8	19.9	25.4	28.7	25.6	33.1
30–34.9	12.4	10.6	10.9	8.8	12.8	8.3	10.4	6.7	15.0	13.6	14.9	15.8
35–39.9	4.8	3.2	4.0	2.5	5.3	2.7	4.6	2.3	7.8	5.4	7.5	4.7
≥40	3.0	1.2	2.1	1.0	2.4	1.2	2.8	1.1	6.3	3.0	3.6	1.6
GDM[c]												
Yes	3.3	5.3	3.4	4.9	4.6	6.9	4.6	5.1	3.5	5.5	2.5	5.9
No	96.7	94.7	96.6	95.1	95.4	93.1	95.4	94.9	96.5	94.5	97.5	94.1

FB, foreign born; GDM, gestational diabetes; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

[a]Percentages in the table are percentages of live, singleton deliveries that are not missing values of the characteristic.

[b]Chinese, Japanese, Korean.

[c]Counts of records with missing values of BMI or GDM status are not shown because deliveries with missing values of these variables were excluded from the study.

TABLE 2

Absolute and relative risks (RR) for gestational diabetes mellitus (GDM) associated with prepregnancy BMI

	US-born			Foreign-born			
	Standardized mean risk (%)			Standardized mean risk (%)			
Ethnic group	**BMI 18.5–24.9**	**BMI > 25**	**RR[a] (CI)**	**BMI 18.5–24.9**	**BMI ≥ 25**	**RR (CI)**	***P* for difference in RRs**
Asian Indian	3.6	11.7	3.2 (1.5–6.9)	10.9	16.7	1.5 (1.3–1.8)	0.08
Vietnamese	5.8	9.1	1.6 (0.5–5.2)	10.7	14.4	1.3 (1.0–1.9)	0.74
East Asian[b]	5.4	10.4	1.9 (0.9–4.3)	8.0	13.9	1.7 (1.3–2.3)	0.85
Filipina	3.6	10.9	3.1 (1.5–6.0)	9.0	19.8	2.2 (1.8–2.7)	0.48
Combined Asian/Filipina	4.1	11.5	2.8 (1.9–4.1)	9.7	16.5	1.7 (1.5–1.9)	0.03
Mexican	2.0	6.4	3.2 (2.6–3.9)	4.9	10.8	2.2 (1.9–2.6)	0.02
Cuban	1.9	5.0	2.7 (2.2–3.2)	3.5	7.6	2.2 (1.9–2.5)	0.15
Central/South American	2.0	5.1	2.6 (2.0–3.3)	3.6	7.2	2.0 (1.8–2.2)	0.09
Other Hispanic	3.0	6.5	2.2 (1.7–2.8)	5.1	10.4	2.1 (1.8–2.4)	0.89
Combined Hispanic	2.1	5.7	2.7 (2.4–3.0)	3.9	8.2	2.1 (2.0–2.2)	<0.01
Non-Hispanic white	2.7	7.5	2.8 (2.7–2.9)	3.5	8.7	2.5 (2.2–2.8)	0.15
Non-Hispanic black	1.7	5.0	2.9 (2.7–3.2)	3.3	7.7	2.3 (2.0–2.7)	0.02
Haitian	1.1	4.0	3.8 (2.1–7.2)	3.2	7.9	2.5 (2.1–2.9)	0.23

All models are adjusted for age, parity, and height.

CI, confidence interval.

[a]RRs are for high BMI relative to normal BMI.

[b]East Asian refers to Chinese, Japanese, and Korean.

TABLE 3

Relative risk (RR) of gestational diabetes mellitus (GDM) among foreign-born mothers compared with US-born women, unadjusted and adjusted models

Ethnic group	Unadjusted RR (CI)	Adjusted for BMI, age, and parity RR (CI)	Adjusted for BMI, age, parity, and mother's height RR (CI)
Asian Indian	2.3 (1.5–3.3)	2.2 (1.5–3.2)	2.1 (1.4–3.1)
Vietnamese	1.4 (0.8–2.5)	Insufficient data	Insufficient data
East Asian[a]	1.3 (0.9v2.0)	1.4 (0.9–2.2)	1.4 (0.9–2.1)
Filipina	1.9 (1.3–2.6)	1.9 (1.3–2.6)	1.8 (1.3–2.5)
Combined Asian/Filipina	1.8 (1.5–2.2)	1.8 (1.4–2.2)	1.7 (1.4–2.1)
Mexican	1.8 (1.6–2.0)	1.6 (1.4–1.7)	1.5 (1.4–1.7)
Cuban	1.6 (1.4–1.7)	1.5 (1.4–1.7)	1.5 (1.3–1.7)
Central/South American	1.5 (1.3–1.6)	1.3 (1.2–1.5)	1.3 (1.1–1.5)
Other Hispanic	1.5 (1.3–1.7)	1.4 (1.2–1.7)	1.4 (1.2–1.6)
Combined Hispanic	1.5 (1.4–1.5)	1.5 (1.4–1.6)	1.5 (1.4–1.5)
Non-Hispanic white	1.1 (1.0–1.2)	1.1 (1.1–1.2)	1.1 (1.1–1.2)
Non-Hispanic black	1.6 (1.5–1.7)	1.3 (1.2–1.4)	1.3 (1.2–1.4)
Haitian	2.3 (1.8–3.0)	1.8 (1.4–2.3)	1.7 (1.4–2.2)

CI, confidence interval.

[a]East Asian refers to Chinese, Japanese, and Korean.