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Los Angeles

Prepregnancy Risk Factors for Preterm Birth in a Hispanic WIC Population

A thesis submitted in partial satisfaction

of the requirements for the degree Master of Science

in Epidemiology

by

Stephanie A. Leonard

ABSTRACT OF THE THESIS

Prepregnancy Risk Factors for Preterm Birth

in a Hispanic WIC Population

by

Stephanie A. Leonard

Master of Science in Epidemiology

University of California, Los Angeles, 2014

Professor Susan D. Cochran, Chair

Despite improvements in prenatal healthcare, preterm birth remains the leading cause of infant mortality. The causes of preterm birth are not well-understood, especially in Hispanics—who nationally have preterm birth rates comparable to non-Hispanic whites despite socioeconomic disadvantages. Even less understood are the effects maternal nativity may have on the causes of preterm birth. This study aims to assess prepregnancy risk factors for preterm birth in a Hispanic population of WIC participants in Southern California, if prevalence of preterm birth differs by maternal nativity, and whether there is effect measure modification of any associations between risk factors and preterm birth by nativity on the multiplicative scale. Cross-sectional survey data (N = 1174) were collected within one year postpartum and assessed by logistic regression with sampling weights. After adjustment for confounders, risk factors for preterm birth were maternal

age 35 or older, and stressful life events among U.S.-born but not foreign-born women. The prevalence of preterm birth in this low-income study population (15.1%) suggests the risk of preterm birth in Hispanic women may be low relative to non-Hispanic black women. Further investigation with large, prospective studies is needed to better understand the causes of and disparities in preterm birth among the growing Hispanic population in the U.S.

The thesis of Stephanie A. Leonard is approved.

Catherine M. Crespi

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Susan D. Cochran, Committee Chair

University of California, Los Angeles

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INTRODUCTION

Preterm birth is the leading cause of infant death in the United States and puts infants at increased risk of a number of health and developmental problems.[1,2] Preterm birth also carries a large economic burden for both families and society, with the annual economic burden in the U.S. estimated to be over $26 billion in 2005.[3] Despite improved prenatal care in recent decades, an estimated 11.6% of infants in the U.S. are born preterm (before 37 wk gestation), compared to 10.3% of infants born in 1990.[4,5] Some prepregnancy maternal risk factors for preterm birth have been identified, particularly low socioeconomic and educational status, short spacing between pregnancies, and high and low maternal age.[2,3] However, the complexity and overlap of risk factors are not well understood and their mechanisms are unknown.[2] Potential risk factors that may be modifiable, such as physical activity and body mass index (BMI), have also not been well-studied although they may present the best opportunities to prevent preterm birth.[2] Studies on the causes of preterm birth have also often used low birthweight as a weak proxy condition.[3] Additionally, many studies have not included Hispanics and Latinos despite complex and persistent racial-ethnic disparities in preterm birth risk, which suggest that risk factors may differ by race-ethnicity.[3,5,6]

Within racial-ethnic groups, low socioeconomic status is a major risk factor for preterm birth and other adverse birth outcomes.[3] However, non-Hispanic black women have been found to be at higher risk of adverse birth outcomes than non-Hispanic white women even after adjusting for socioeconomic factors.[2,3] Additionally, Hispanic women in the U.S. have risks of low birthweight and infant mortality that are comparable to non-Hispanic white women,

although they are one of the most socioeconomically disadvantaged groups in the country.[4] This Hispanic Paradox is not well-understood, but has been most evident in women of Mexican and Central American origin.[7] The Hispanic Paradox has also not been consistently observed in studies on preterm birth. In a 2013 meta-analysis on racial-ethnic disparities in the risk of preterm birth, Schaaf et al.[6] found 11 studies that reported on Hispanic ethnicity, of which six studies did not differentiate Hispanic groups. Of those six studies, three reported a significantly lower risk of preterm birth in Hispanic women compared to non-Hispanic white women and three reported a significantly higher risk. These conflicting results highlight the need for additional research to better understand if and how preterm birth risk may differ between Hispanic and non-Hispanic populations.

A proposed explanation of the Hispanic Paradox is the healthy migrant theory, which proposes that Hispanic women who immigrate to the U.S. are particularly healthy and this healthiness results in relatively positive birth outcomes.[7] A few studies have supported this theory with findings that Hispanic women who were foreign-born or recent immigrants were at lower risk of delivering preterm than other Hispanic women.[8–10] Overall, however, there is a lack of necessary information to assess if and how nativity affects risk of preterm birth. In its 2006 report on preterm birth, the Institute of Medicine concluded that the potential causes of racial-ethnic disparities in preterm births are not well-understood and the effects of nativity even less so.[3]

The need for information on the causes of preterm birth is particularly pressing for the U.S. Hispanic population, which has been growing rapidly over the past several decades. There are approximately 53 million Hispanics living in the U.S., comprising 17% of the total population.[11] Of all Hispanics in the U.S., 73% are of Mexican or Central American origin.[11]

Additionally, the U.S.-born Hispanic population has been growing at a faster rate than the immigrant Hispanic population since 2000.[11] In California, 50% of all infants born in 2012 were Hispanic and Hispanic children now outnumber non-Hispanic white children.[4,12] With the burgeoning growth of the Hispanic population, health practitioners and agencies—including the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)—will be providing more services to Hispanic women, infants, and children. More information is needed to help such providers, as well as policy makers, identify Hispanic women who are at increased risk of preterm birth and provide prepregnancy services to mitigate this risk.

This study aims to assess potential prepregnancy risk factors for preterm birth in a low-income, Hispanic population of WIC participants based on characteristics that have been recognized as potential risk factors in non-Hispanic populations. An additional aim of this study is to assess if the prevalence of preterm birth differs by nativity in this population, and if there is effect measure modification of any associations between risk factors and preterm birth by nativity on the multiplicative scale. Based on studies in non-Hispanic populations, it is hypothesized that the strongest risk factors for preterm birth in this low-income population will be maternal age, education, and recent stressful life events. Additionally, based on the healthy migrant theory, it is hypothesized that the prevalence of preterm birth will be lower in women outside the U.S. and that significant risk factors will differ by nativity.

METHODS

Study population

The study population included mothers participating in WIC and living in Los Angeles or Orange Counties in Southern California. Two samples were taken from the study population, with the first selected by random sampling. The second sample was randomly selected from only those mothers who, according to WIC records, delivered preterm (<37 wk gestation). Duplicate subjects were removed by comparing the two samples. Figure 1 contains details on study population selection. Women were not eligible for the study if they did not speak English or Spanish, were currently pregnant, or did not give birth within the past year. Additionally, the results shown include information only from participants who reported if their most recent delivery was preterm, self-identified as being "of Latino or Hispanic origin," and did not have multiple births within the past year, as preterm delivery is more common and has a different etiology when there are multiple births. A total of 1,174 participants, including 834 from the main sample and 340 from the preterm sample, were included in the final analyses.

The survey cooperation rate was 87.8% for the main sample and 85.1% for the preterm sample. The response rate was 42.8% for the main sample and 44.3% for the preterm sample. This research was approved by the E and I Institutional Review Board and verbal consent was obtained from each respondent.

Survey Development and Administration

The research team developed the study questionnaire in English through careful review of validated questionnaires. The questionnaire was then translated into Spanish and both language versions were programmed into a computer-assisted telephone interviewing (CATI) system. Before beginning full-scale data collection, the English and Spanish questionnaires were pre-tested among a small convenience sample of postpartum WIC participants. The questionnaires and survey administration were revised accordingly following the pre-testing. The final survey was piloted among 10 English-speaking and 10 Spanish-speaking mothers, whose data are included in this study.

All interviewers received training to conduct the survey, including mock interviews and a briefing session. Additional debriefing and retraining sessions were held during the data collection period. Interviewers used a CATI system to administer the survey between July 30 and August 17, 2010. Each interview took approximately 20 minutes.

Variables

The study questionnaire was used to collect participants' sociodemographic information, information on their health-related characteristics and behaviors before, during, and after pregnancy, and information on the birth outcomes of their most recent and all previous pregnancies. The outcome of interest was preterm birth, defined as <37 wk gestation, using self-report of delivery more than 3 weeks before the due date.

Survey questions included in this study as potential risk factors for preterm birth included sociodemographic characteristics (age, education status, and health insurance coverage before pregnancy), prepregnancy health-related behaviors (alcohol use, multivitamin or folic acid supplementation, exercise frequency, and whether pregnancy was intended,) and prepregnancy

health characteristics (depressive symptoms, stressful life events, diabetes, high blood pressure, teeth or gum problems, BMI, gravidity, and birth interval.) We also investigated effect measure modification of associations between risk factors and preterm birth by maternal nativity on the multiplicative scale.

Maternal ages were categorized into 18-24 y, 25-29 y, 30-34 y, and ≥35 y. Education levels were grouped into less than high school completion, high school graduate, and at least some college or trade school. Prepregnancy health insurance status was grouped as any or none.

Maternal alcohol use prepregnancy was categorized as weekly or less than weekly, based on evidence that only heavy alcohol drinking during pregnancy increases the risk of preterm birth.[3] Multivitamin or folic acid supplementation prepregnancy was grouped as daily or not daily, based on national recommendations for women who may become pregnant.[13] Prepregnancy frequency of leisure time exercise of at least 30 minutes was categorized into weekly or less than weekly, based on national physical activity guidelines.[14] Participants self-reported whether their pregnancy was intended, unintended, or their intentions kept changing.

Prepregnancy depression was assessed by 2 questions adapted from the validated Patient Health Questionnaire-2.[15] Subjects were asked if, for a period of 2 weeks or longer before pregnancy, (1) they ever felt sad, empty, or depressed for most of the day and/or (2) if they lost interest in most things they usually enjoyed doing. Responses were grouped into any or no depressive symptoms. Prepregnancy stress was assessed based on the Holmes and Rahe Stress Scale[16] by asking if 12 different stressful life events occurred over the past 2 years and before pregnancy, such as if "someone close to you died" or "you lost your job even though you wanted to go on working." Subjects were grouped for analyses into any or no stressful life events prepregnancy.

Prepregnancy diabetes or high blood sugar, high blood pressure or hypertension, and teeth or gum problems were self-reported as yes or no if they occurred at any time over the past 2 years and before pregnancy. Prepregnancy BMI values were calculated from self-reported maternal heights and weights from the month before pregnancy. BMI values were categorized into normal- or underweight (<25 kg/m^2), overweight (25-29.9 kg/m^2), and obese (≥ 30 kg/m^2), because of few underweight participants. Gravidity was grouped into no previous pregnancies (primigravida) and any previous pregnancies (multigravida). Maternal nativity was self-reported by responding if born in the U.S. or outside the U.S.

Statistical Analysis

The distributions of the potential prepregnancy risk factors and preterm birth were estimated among all study participants. Comparisons of these variables between included and excluded participants were made using chi-square tests. Associations between each risk factor and preterm birth were assessed with univariate logistic regression models. A multivariate logistic regression model was then used that included all risk factors as predictors to adjust for confounding. All risk factors were evaluated for multicollinearity.

Effect measure modification of each association between the risk factors and preterm birth by maternal nativity on the multiplicative scale was assessed with univariate logistic regression models that included two-way interaction terms between the risk factor and nativity. Any interaction term with a statistically significant and stable effect estimate was added to the final multivariate model.

All statistical analyses used sampling weights to realign the distribution of the study sample with the true population proportions of full-term and preterm births. Differences were

considered statistically significant at $P<0.05$. All analyses were conducted using SAS (version 9.3; SAS Institute Inc, Cary, NC, 2011).

RESULTS

Descriptive Statistics

The prevalence of preterm birth in the study population was 15.1% (Table 1). Overall, most women in the study population were under 30 years old, had a high school degree or less, and did not have any healthcare coverage before becoming pregnant. Before pregnancy, 95.5% of women drank alcohol less than weekly, 24.1% took multivitamin or folic acid supplements daily, and 24.1% exercised for 30 minutes or more at least once per week. Half of pregnancies were intended, 35.5% were not intended, and for 14.7% intentions kept changing. In terms of prepregnancy health, 21.3% of women had depressive symptoms during the past 2 years and 52.3% experienced a stressful life event. There were 1.1% of women with diabetes or high blood sugar, 1% with high blood pressure, and 5.4% with teeth or gum problems. One month before pregnancy, 43.8% of women were normal-weight, 30.4% were overweight, and 25.8% were obese. The majority of women were multigravida.

Participants who were excluded from statistical estimates differed significantly from those included in several characteristics (Table 1). Excluded participants tended to be older, more educated, have health insurance prepregnancy, and have lower weight status than included participants. A higher proportion of excluded participants also reported drinking alcohol at least weekly and taking a multivitamin or folic acid supplement daily.

Logistic Regression Models

Maternal age 30 y and older, infrequent leisure time exercise, and high blood pressure prepregnancy were significantly associated with increased odds of preterm birth in univariate

analyses (Table 2). Compared to women 18-25 y, the odds of preterm birth were 1.6 times higher in women 30-34 y and 1.8 times higher in women ≥35 y. The odds of preterm birth in women who exercised less than once per week were 1.5 times higher than in those who exercised at least once per week, and were 3.6 times higher in women with high blood pressure than in those without high blood pressure. The associations of preterm birth with depressive symptoms (P=0.054) and with stressful life events (P=0.061) bordered on the P<0.05 statistical significance threshold. The odds of preterm birth were numerically higher in women who experienced depressive symptoms or any stressful life events. No other associations between potential risk factors and preterm birth were significant in univariate analyses. In multivariate analysis with all potential preterm birth predictors, only maternal age of 35 y or older (OR=1.93; 95% CI: 1.03, 3.63) was significant. There was no multicollinearity detected among the predictor variables.

Effect Measure Modification by Maternal Nativity on the Multiplicative Scale

In unadjusted analysis, maternal nativity was not associated with preterm birth (P=0.19). However, the weighted prevalence of preterm birth was numerically higher in women not born in the U.S. (16.3% vs. 13.5%). There was also significant effect measure modification of the association between prepregnancy stressful life events and preterm birth by maternal nativity on the multiplicative scale. Among women born in the U.S., having experienced any stressful life event prepregnancy was associated with 2.4 times (95% CI: 1.36, 4.07) increased odds of preterm birth compared to no stressful life events. There was no association between stressful life events and preterm birth in women not born in the U.S. There were possibly higher odds of preterm birth in foreign-born participants with diabetes or high blood pressure prepregnancy, but

the low number of foreign-born women with these characteristics made these estimates unreliable.

After adding the significant interaction term to the final multivariate model, significant predictors of preterm birth included maternal age of 35 y or older in all women and stressful life events in U.S.-born women (Table 3).

DISCUSSION

Prepregnancy risk factors for preterm birth in this low-income, Hispanic population included advanced maternal age and stressful life events among U.S.-born but not foreign-born women. Before adjustment for confounding, infrequent exercise, high blood pressure, and depressive symptoms were also related to increased odds of preterm birth. Additionally, the prevalence of preterm birth in this population was higher than the national estimate for Hispanic women of all income levels, but still lower than the estimate for black women of all income levels.[17] Preterm birth was also numerically more prevalent in U.S.-born women than foreign-born women, but this difference was not significant. The findings of this study may support the Hispanic Paradox for preterm birth, but do not support the healthy migrant theory.

Major racial-ethnic and socioeconomic disparities in preterm birth have persisted in the U.S. despite improvements in pre- and perinatal healthcare. This study focused on a vulnerable, understudied, and rapidly growing U.S. subpopulation: low-income women of Hispanic origin. Consistent with previous studies, women age 35 and older in this study population had odds of preterm birth nearly two times as high as women age 18 to 25.[2,3] These increased odds remained even after adjusting for diabetes and hypertension, which have been hypothesized to explain the association between maternal age and preterm birth.[3] Maternal age has been increasing nationally in all races and ethnicities, including Hispanics.[4] This study's findings support the need for further research on the causes of preterm birth in older mothers and the inclusion of maternal age as a confounder in causative research on preterm birth.

In contrast to studies in other populations, there was no association found between maternal education status and preterm birth. The low socioeconomic and educational status of

the study population could provide a possible explanation if education status only has a beneficial effect if it is beyond high school or there is a commensurate rise in economic status.

As found in previous studies, individual prepregnancy behaviors did not have strong associations with preterm birth.[3] The only significant behavioral association was 50% higher odds of preterm birth in women who exercised less than once per week before pregnancy compared to women who exercised at least once per week, although this association was not significant after adjustment for confounding. Studies on physical activity and preterm birth have produced mixed results; the effects of work-related physical activity may be harmful while leisure time physical activity may be beneficial.[2,3] This study, which asked women about leisure time exercise, would be consistent with the mixed findings on physical activity.

In this study, experiencing a stressful life event prepregnancy was associated with a greatly increased risk of preterm birth among U.S.-born women. Highly stressful life events have been found to be significant predictors of preterm birth in other studies,[18,19] although Lu and Chen[20] did not find any interaction effects between race-ethnicity and stressful life events (before or during pregnancy) on preterm birth using national surveillance data. In this study, the effect measure modification of the association between prepregnancy stressful life events and preterm birth by nativity on the multiplicative scale suggests that prepregnancy stress may partially explain differences in preterm birth risks between women born in the U.S. and those who immigrate to the U.S. However, further investigation in prospective cohort studies is warranted.

Consistent with other studies and national surveillance data, the prevalence of preterm birth in this Hispanic population (15.1%) was less than the national prevalence in non-Hispanic black women (17.1%) but higher than in non-Hispanic white women (10.8%) during the same

year.[17] The prevalence was also higher than the national prevalence of preterm birth in Hispanic women (11.8%).[17] A possible explanation for the higher prevalence in this study population is its low socioeconomic status, given the strong association between low socioeconomic status and preterm birth observed in other studies.[2,3] Despite being a highly disadvantaged population, preterm birth was still less prevalent in this study population than among non-Hispanic black women of all socioeconomic statuses in national surveillance data. These preterm birth results therefore likely provide support for the Hispanic Paradox that has been observed for infant mortality and low birthweight.

Additionally, this study adds to the mixed evidence on the relationship between maternal nativity and preterm birth. Maternal nativity was not associated with preterm birth in this study, although prevalence was numerically lower in U.S.-born women. Studies have shown maternal birth in Mexico or Central America to have a modestly beneficial influence on preterm birth.[9,10,21,22] In a 1996 national study, Singh et al.[10] found the prevalence of preterm birth to be 11.8% in U.S-born Mexican-Americans vs. 10.0% in foreign-born Mexican Americans, and 10.6% in U.S.-born Central and South Americans vs. 10.1% in foreign-born Central and South Americans. Similarly in a 2011 study in New York City by Kaufman et al.,[9] the prevalence of preterm birth was 6.3% in both U.S.-born and foreign-born Mexican-Americans, and was 7.1% in U.S.-born Central Americans vs. 7.0% in foreign-born Central Americans. These findings, as well as the effect measure modification by nativity observed in this study, highlight the need for more research on the role maternal nativity may play in preterm birth and the Hispanic Paradox.

The results from this study are limited by a cross-sectional, retrospective study design, which may have introduced recall bias. The self-reported data also may have introduced misclassification, although a previous study validated self-reported survey data in the same study

population.[23] The sample size was not adequate to thoroughly assess certain potential risk factors, including short birth spacing, maternal underweight, diabetes, and high blood pressure. Additionally, the distributions of several potential risk factors differed considerably between study participants included in the analyses and those excluded from the analyses, who were predominantly non-Hispanic. The results, therefore, may not be applicable to the entire study population of WIC participants, particularly women who are not Hispanic.

A major strength of this study is its preterm augment sample, which provided a sufficient sample size to assess preterm birth. Minimal differences in cooperation and response rates between the main sample and preterm sample also indicate that response bias is unlikely. An additional strength of the study is that it controlled for race-ethnicity and economic status by design.

CONCLUSION

The findings of this study contribute to the limited understanding of the causes of preterm birth, particularly in Hispanics. Many health and human service providers in Southern California already serve a predominantly Hispanic population and the number of Hispanics nationwide, especially U.S.-born, is expected to continue to rise. The results of this study suggest that experiencing stressful life events before pregnancy may be a significant risk factor for preterm birth in low-income, Hispanic women who are born in the U.S. Advanced maternal age may also be a risk factor for preterm birth, and should be of concern with the upward trend of women giving birth later in life. Additionally, risk factors for preterm birth may be different for Hispanic women than for women of other ethnicities, and may also differ by maternal nativity. Prospective, large cohort studies with Hispanic women are needed to better understand these differences and assess any causal relationships between maternal prepregnancy characteristics and preterm birth.

Figure 1. Study sample selection process from the study population.

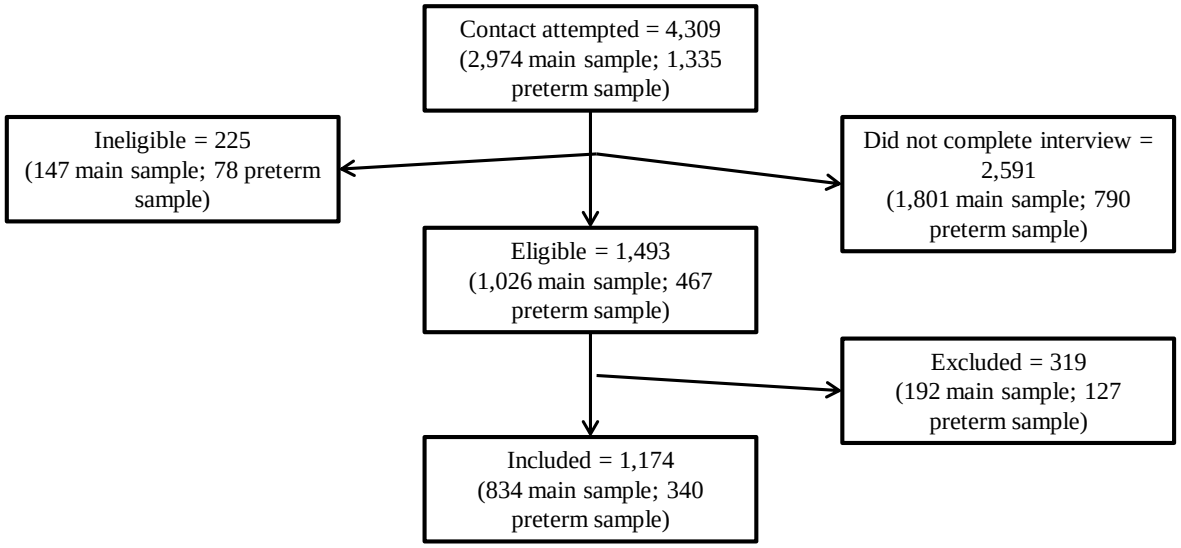

Table 1. Comparison of the distributions of potential risk factors for preterm birth between study participants who were included in the analyses (n = 1174) and those who were excluded from analyses (n = 319) (weighted).

Variables	Included (%)	Excluded (%)	P-value[1]
Sociodemographic factors			
Age (n = 1478)			0.02
18-24 y	37.6	26.6	
25-29 y	25.0	30.0	
30-34 y	21.7	26.3	
≥35 y	15.7	17.0	
Education (n = 1493)			<0.0001
Less than high school completion	42.9	13.1	
High school graduate	32.9	27.9	
At least some college or trade school	24.2	58.9	
Health insurance prepregnancy (n =1485)			<0.0001
Any	44.9	64.0	
Health behaviors			
Alcohol use prepregnancy (n = 1482)			0.0007
Weekly	5.5	12.0	
Folic acid or multivitamin supplementation prepregnancy (n = 1484)			0.03
Daily	24.1	31.4	
Exercise (n = 1489)			0.09
At least once per week	23.6	29.2	
Pregnancy intention (n = 1470)			0.09
Intended	49.7	41.4	
Intention kept changing	14.7	16.2	
Not intended	35.5	42.4	
Health characteristics			
Depression prepregnancy (n = 1490)			0.47
Yes	21.3	19.1	
Stressful life events prepregnancy (n = 1493)			0.07
One or more	52.3	59.0	
Diabetes prepregnancy (n = 1491)			0.94
Yes	1.1	1.2	
High blood pressure prepregnancy (n = 1491)			0.91
Yes	1.0	1.0	
Teeth or gum problems prepregnancy (n =			0.52

1492)			
Yes	5.4	4.3	
BMI prepregnancy (n = 1148)			0.0001
Normal weight	43.8	61.2	
Overweight	30.4	21.5	
Obese	25.8	17.3	
Gravidity (n = 1491)			0.71
Primigravida	28.5	29.7	
Multigravida	71.5	70.2	
Preterm birth (n = 1486)			0.91
Yes	15.4	15.1	

[1]Chi-square test used

Table 2. Unadjusted logistic regression results for associations between maternal prepregnancy characteristics and preterm birth.

Variables	Unadjusted OR (95% confidence limits)
Sociodemographic factors	
Age (n = 1478)	
18-25 y)	1.00
25-29 y	1.04 (0.67, 1.62)
30-34 y	1.57 (1.01, 2.45)[1]
≥35 y	1.83 (1.15, 2.91)[1]
Education (n = 1493)	
Less than high school graduate	1.00
High school graduate	1.01 (0.7, 1.47)
More than high school education	0.85 (0.56, 1.3)
Health insurance (n = 1485)	
None	1.00
Any	1.10 (0.79, 1.52)
Health behaviors	
Alcohol use (n = 1482)	
<Weekly	1.00
≥Weekly	0.81 (0.37, 1.76)
Folic acid or multivitamin use (n = 1484)	
Daily	1.00
<Daily	0.71 (0.49, 1.02)
Exercise frequency (n = 1489)	
≥Weekly	1.00
<Weekly	1.50 (1.01, 2.22) [1]
Pregnancy intention (n = 1470)	
Intended	1.00
Intentions kept changing	0.65 (0.39, 1.07)
Not intended	0.82 (0.57, 1.16)
Health characteristics	
Depressive symptoms (n = 1490)	
No	1.00
Yes	1.46 (0.99, 2.14)
Stressful life event (n = 1493)	
No	1.00
Yes	1.37 (0.99, 1.89)
Diabetes (n = 1491)	
No	1.00
Yes	2.67 (0.8, 8.94)
High blood pressure (n = 1491)	
No	1.00
Yes	3.6 (1.08, 12.02) [1]
Teeth or gum problems (n = 1492)	

No	1.00
Yes	1.1 (0.53, 2.21)
Body mass index (n = 1148)	
Normal weight	1.00
Overweight	0.96 (0.62, 1.5)
Obese	1.26 (0.79, 1.99)
Gravidity (n = 1491)	
Multigravida	1.00
Primigravida	0.75 (0.52, 1.08)

[1] P<0.05

Table 3. Adjusted logistic regression results for associations between maternal prepregnancy characteristics and preterm birth (n = 840).

Variables	Adjusted OR (95% CI)
Sociodemographic factors	
Age (ref = 18-25 y)	
25-29 y	0.79 (0.43, 1.46)
30-34 y	1.31 (0.72, 2.39)
≥35 y	1.96 (1.03, 3.73)[1]
Education (ref = Less than high school graduate)	
High school graduate	1.29 (0.81, 2.0)
More than high school education	0.99 (0.57, 1.72)
Health insurance (ref = None)	1.01 (0.68, 1.51)
Health behaviors	
Alcohol use (ref = <Weekly)	0.74 (0.3, 1.86)
Folic acid or multivitamin use (ref = Daily)	0.74 (0.48, 1.15)
Exercise frequency (ref = ≥Weekly)	1.52 (0.92, 2.5)
Pregnancy intention (ref = Intended)	
Intentions kept changing	0.55 (0.3, 0.99)
Not intended	0.75 (0.49, 1.17)
Health characteristics	
Depressive symptoms (ref = No)	0.87 (0.51, 1.47)
Stressful life event (ref = No)	
In U.S. born	2.33 (1.27, 4.28)[2]
In foreign born	0.87 (0.51, 1.5)
Diabetes (ref = No)	1.30 (0.25, 6.82)
High blood pressure (ref = No)	2.79 (0.59, 13.1)
Teeth or gum problems (ref = No)	0.77 (0.24, 2.44)
Body mass index (ref = Normal weight)	
Overweight	0.90 (0.57, 1.43)
Obese	1.16 (0.7, 1.92)
Gravidity (ref = Multigravida)	1.00 (0.60, 1.69)

[1] P=0.04

[2] P=0.007

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