Association between the number of visits during prenatal care and the occurrence of low birth weight in the United States

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Abstract

Background

Low birth weight (LBW) is one of the major child and infant health issues in the United States, standing as one of the main causes of child and infant mortality. While the importance of prenatal visits regarding pregnancy outcomes is recognized, its relationship with birth weight is still a matter of debate.

Objectives

This study examines the relationship between the number of prenatal visits and low birth weight among children born in the United States in 2017.

Study design

Data from the CDCs Online Birth Databases are used for this study. 3,864,754 registered children born in the U.S. in 2017 are included in the analyses. The databases also include information on maternal characteristics, pregnancy history and prenatal care characteristics, pregnancy risk factors, delivery characteristics, and infant characteristics.

The outcome variable is low birth weight, defined as weight at birth lower than 2500 grams. The independent variable is the number of prenatal visits grouped in three categories (no visit, 10 visits or less, and more than 10 visits. Confounding and covariates include prematurity and plurality among others. Multiple logistic regression modeling was used, reporting unadjusted and adjusted odds ratios with corresponding 95% confidence intervals.

Results

Data from the CDCs Online Birth Databases are used for this study. 3,864,754 registered children born in the U.S. in 2017 are included in the analyses. The databases also include information on maternal characteristics, pregnancy history and prenatal care characteristics, pregnancy risk factors, delivery characteristics, and infant characteristics.

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Conclusion

This study reveals that the number of prenatal visits has an inverse relationship with low birth weight, even when confounding and other factors are accounted for. These findings are compatible with the notion that the more a woman goes for prenatal visits, the more likely it is to detect risks of negative pregnancy outcomes.

Introduction

Antenatal care (ANC) is the care given on a regular basis to the pregnant woman by professional healthcare workers from conception till to the onset of labor through the delivery (Alexander & Korenbrot, 1995). It is tailored as preventive care delivery, that is provided to pregnant women during antenatal visits essentially to ensure the wellbeing of the mother and the unborn child (CDC, 2020). It is generally seen to prevent any disease or untoward pregnancy-related health outcome which can be fatal to both the mother as well as to the fetus. The World Health Organization (2016) formulated 39 recommendations on ANC activities which are classified into five types: nutritional interventions, maternal and fetal assessment, preventive measures, interventions for common physiological symptoms, and health system interventions to improve utilization and quality of ANC for a positive pregnancy experience and a safe delivery. That results in a healthy normal birth weight baby, at least 2500 kg, and mother having completed at least 37 weeks of gestation.

However, despite these various preventive expectations of ANC visits. There exist controversy over whether ANC is a good predictor for Low Birth Weight (LBW), a gap that this work seeks to fill by looking out for any association between ANC visit and the occurrence of low birth weight baby. This is because some earlier studies such as those by Alexander & Korenbrot (1995) and Paneth (1995) argued that there was no empirical evidence that supported this cause and effect relationship between ANC visits and low birth weight. However, in another study, Saaka & Rauf (2013) concluded contrarily that adequate prenatal visits are real means of preventing LBW babies, especially in rural communities and mostly for unemployed women or women with low socioeconomic status. Zhou et al. (2019) also found an affirmative conclusion that LBW was positively associated with not attending at least five to eight ANC visits, not receiving any ANC visits during the first trimester, and not having access to certain ANC visits content assessment and intervention like weight, blood pressure, blood test, urine test, B-scan ultrasound, and folic acid supplement. Also, in another study carried out using demographic and health survey data from 10 developing countries Mahumud, et al. (2017) found also that inadequate ANC visits are an independent predictor of LBW. Since LBW occurrence in the newborn is very implicative in associated morbidity and mortality of affected babies.

Therefore, these inconclusive findings necessitate more scrutiny into the question of the association between the number of ANC visits and LBW to help populate data on informing preventive policy formulation, and health care practice delivery. Affirmatively, this study hypothesizes that the number of ANC visits is a significant determinant of birth weight as a pregnancy outcome. This is based on cross-sectional data of pregnancy outcomes of 3,864,754 women who received different amounts of ANC visits in the United States of America.

Methods

Data source

This study used data from the United States Centers for Disease Control and Prevention's 2017 online natality databases. The CDC is one of the important agencies for the Department of Health and Human Services. The CDC Births Online Databases report birth rates, fertility rates, and counts of live births occurring within the United States to U.S. residents and non-residents. The data, available since 1995, were derived from birth certificates. They were produced by the National Center for Health Statistics. So it was a secondary dataset based on cross-sectional observations of the natality in the 50 states, including the District of Columbia and United States Territories.

Study sample

The data covered all 3,864,754 registered children born in the U.S. in 2017 to U.S. resident or non-resident mothers. To ensure the confidentiality of the respondents, the public-use file of this dataset did not include any identifier information. The Male partners were excluded.

Study variables

The key outcome variable was birth weight, classified into two categories, low and normal. In the raw data, weight data were collected as a quantitative variable in grams. LBW was defined in this study as weight at birth below 2500 grams. Weights of 2500 grams of above were considered normal. The main independent or exposure variable was prenatal visits, initially collected as the exact number of visits and then classified in this study into three groups: no visit, 1 to 10 visits, and more than 10 visits.

Besides, several covariates have been identified and were examined in the analyses. These include gestational age, mother's age, mother's education, mother's race, gender, congenital anomalies, type of payment, WIC, parity, singleton birth, mother's weight gain, five minutes APGAR, pre-pregnancy diabetes, pre-pregnancy hypertension, paternity acknowledgment, and mother's body mass index. Details in the handling of specific quantitative and categorical variables were provided as follows ;

Gestational age: was categorized into two groups of less than 37 weeks and 37 weeks and higher.

Mother's age: was recoded into three age groups: <18, 18-35, and more than 35.

Mother’s Education categories were initially classified into 9 categories, but for our analyses, we regrouped into three broader categories: college or less, undergraduate, and graduate.

Mother's race is presented in the database as "bridged race" in four categories – White, Black or African American, American Indian or Alaska Native, and Asian or Pacific Islander.

Five-minute APGAR was initially recorded as a score ranging from 0 to 10. We recoded into two groups as follows: up to 7 (low) and Above 7 (good) because, in the literature, a score of 8 or above is a better predictor of the viability of the child.

Payment Recode: Four options for the source of payment at delivery were identified in a checkbox format: private insurance, Medicaid, self-pay, and others to be specified.

Parity was recorded as the number of live birth and recoded in two categories: primipara and multipara.

Mother’s Weight gain during pregnancy was recoded into two categories: 10 kg or less and more than 10 kg.

As a dichotomous variable, Gender was classified into males and females.

Our variable concerning singleton was regrouped into two 2 categories singleton birth and multiple births. This variable, together with gestational age was considered as a potential confounder.

Other variables such as pre-pregnancy diabetes, pre-pregnancy hypertension, paternity acknowledgment, no congenital anomalies, and WIC were recorded as binomial (Yes or No) variables and kept as such in the analyses.

Data analysis

The analysis was conducted using SPSS version 26 for Windows (IBM SPSS). The data were analyzed in three steps. First, we used descriptive analysis tools to produce simple frequencies for categorical variables. Second, the dependent variable birth weight (coded as low or normal) was cross-tabulated with the independent variable and each of the covariates to identify significant associations. In all cases, missing values were excluded from the analyses. The chi-Squared test was used with a 5% level of significance to determine significant associations for categorical variables. Third, the independent variable and all covariates significantly associated with the dependent variable were entered into a multiple logistic regression model with appropriate selection procedures to account for their effect in the relationship between LBW and the number of prenatal visits. In this logistic regression model, unadjusted and adjusted odds ratios are estimated with 95% CI.

Data were presented as simple frequencies, percentages, and eventually graphs for description purposes. Besides, unadjusted and adjusted odds ratios were presented following logistic regression procedures.

Results

Table 1 presents descriptive statistics of the valid sample for the CDC's 2017 natality data. The presentation follows the classification of selected variables in three groups, respectively related to the mother, the pregnancy, and the infant. All 3,864,754 children were included in the analyses.

Outcome variable: Overall, 319,427 children in the dataset present a low birth weight, making a relative frequency of 8.3%.

Maternal characteristics: data in table 1 indicate that almost 80% of women in the sample were between 19 and 35 years of age; 18% were older than 35 years and only 3% were 18 or below. The majority of mothers had a college degree or less, they were primarily white (74%) or Black Americans (15%). In terms of maternal risk factors, 38% of women were primipara and 55% were overweight, with a body-mass index of 25 or more. Nearly 40% of women in the sample were enrolled in a Women, Infants, and Children (WIC) nutrition supplement program.

Pregnancy history and prenatal care: in terms of pregnancy history and prenatal care, about 2% of women had no prenatal visit; 38% of them had between one and ten visits, and 60% more than 10 visits. Less than 1% had any congenital anomaly; 6% had pre-pregnancy diabetes and 6% had pre-pregnancy hypertension. More than 90% of the sample women gained 10 Kg or more during pregnancy

Infant's characteristics: Regarding the infant's characteristics, 51% are male, 97% were singleton births and 96% had a five-minute APGAR score of 7 or above. 88% of all births had a gestational age of fewer than 37 weeks and about 8% had a birth weight below 2500 grams. It is anticipated that the potential confounding factors may be gestational age and multiple births.

Table 2 presents bivariate analyses of birth weight (outcome variable) by the number of prenatal visits (independent variables), confounders (singleton births, and gestational age) as well as other mothers, pregnancy, and infant characteristics. The association between low birth weight and each of the characteristics is assessed using a chi-squared test with a 5% level of significance. The results indicated a statistically significant association between the number of prenatal visits and low birth weight with a p-value of 0.01. Moreover, it appears that the percent of children with low birth weight decreased from 19.5% for women with no visit to 12.1% as the number of prenatal visits increased and 5.3% respectively for women with 10 visits or less and 11 visits or more (see Figure 1).

Table 2 also indicates that all potential confounders and other selected covariates were significantly associated with birth weight, with p-values below 1%.

Regression analyses

Logistic regression analyses were conducted by first, including all explanatory variables one by one to estimate unadjusted odds ratios and, second including the independent, confounding, and all other covariates to estimate adjusted odds ratios. The results were presented in table 3 as both unadjusted and adjusted odds ratios with corresponding 95% confidence intervals. The data are presented using the same groupings as in tables 1 and 2. In the following lines, we highlight some of the main results of this multiple regression analysis.

Unadjusted odds ratios

Based on the unadjusted odds ratios, there is a statistically significant inverse relationship between the number of prenatal visits and low birth weight. Compared to women with more than 10 visits, women with 10 visits or less were almost 2.5 times more likely to give birth to an underweight child (OR=2.46; 95% CI: 2.44-2.48). The observed unadjusted odds ratios were statistically significant at the 5% level. As for women with no prenatal visit, they are 4.3 times more likely to give birth to a child with low birth weight compared with women who have more than 10 antenatal visits.

Regarding plurality, multiple births were 18.5 times more likely to be underweight compared with singletons (OR=18.48; 95%CI=18.27-18.69). Similarly, babies born before 37 weeks of gestational age were 25.6 times more likely to be underweight compared with those born at 37 weeks or later (OR=25.64; 95% CI=25.43-25.85).

Using age 18 or below as a reference, we found that the unadjusted odds ratio of low birth weight among those women aged 19 – 35 was 1.10. This means that there was a 10% increase in the probability of low birth weight for women aged 19-35 as compared with those aged 18 or less. In the same vein, the odds ratio for women aged more than 35 was 0.85, which means that there was a 15% decrease in the probability of low birth weight for that group compared with those aged 18 years or less. Regarding maternal education, women with a graduate degree were considered as a reference. While the unadjusted odds ratios of low birth weight among women with a college degree or less and those undergraduates compared with graduates were all statistically significant. Compared with White women, Black Americans were twice more likely to deliver low birth weight babies (OR=2.01; 95% CI=1.97-2.04) while American Indians and Alaskan natives have a 13% increased risk of delivering low birth babies (0R=1.13; 95% CI=1.06-1.21). The data also shows a 15% increase in the odds of low birth weight for Asian or Pacific Islander women, as compared with White women (OR=1.15; 95% CI=1.12-1.17).

On maternal risk factors, high BMI (overweight) and 10 or more kg weight gain present odds ratios that were below 1 (0.90 and 0.54 respectively) and statistically significant compared with their respective reference categories. This means that women with high BMI were 10% less likely to give birth to an underweight child compared with those of normal weight while those who gain 10 kg or more were 46% less likely to give birth to an underweight child compared with those who gain less than 10 kg.

The unadjusted data also show that participating in a WIC nutrition program resulted in a 20% increased risk of low birth weight. In terms of pregnancy risk factors, women with congenital anomalies were four times more likely to give birth to an underweight child compared with those with no congenital anomalies (OR=4.05; 95% CI=3.91-4.22). Women with pre-pregnancy diabetes present a 13% increase in their risk to give birth to an underweight child and those compared with women without pre-pregnancy diabetes. Also, women with pre-pregnancy hypertension are almost three times more likely to give birth to an underweight child compared with women with ho pre-pregnancy hypertension (OR=2.99; 95% CI=2.96-3.02).

Regarding the source of payment for the pregnancy and delivery care, we selected Medicaid as the reference group. The data, using both unadjusted results, show that women with private insurance are 28% less likely to give birth to an underweight child compared with those under Medicaid. The corresponding figure for women who paid by themselves is 31%.

In terms of the infant's characteristics, the data reveal that male infants are 16% less likely to be born underweight compared with females. In addition, children with an APGAR score above 7 are 6.7 times more likely to be underweight compared with those with an APGAR score of 7 or less.

Adjusted odds ratios

The data in the third column of Table 3 present adjusted odds ratios for each of the variables previously discussed. They confirm a statistically significant relationship between the number of prenatal visits and low birth weight. As with the unadjusted odds ratios, adjusted odds ratios are also statistically significant. The inverse relation found with unadjusted odds ratios remained. The corresponding adjusted odds ratios were smaller than the unadjusted values (1.74 and 2.40 respectively) but still statistically significant at the 5% level. This confirms our hypothesis that the number of prenatal visits impacts birth weight. However, the magnitude of changes in odds ratios from unadjusted to adjusted values indicated that other factors explain part of the relationship between the two variables.

Based on the data in table 3, it also appeared that multiple births have an adjusted odds ratio of 11.12 compared with singleton births. This is indicative that multiple births are 11 more likely to result in low birth weight. This is a sharp drop from the unadjusted value, indicating that other factors were at play in explaining the relationship between plurality and low birth weight. A similar conclusion could be drawn for premature children (resulting from pregnancies of less than 37 weeks gestational age), where the odds ratio dropped from 25.6 to less than 12.

On maternal characteristics, there is a significant and positive association between a mother's age and the probability of low birth weight. Using age 18 or below as a reference, we found that the adjusted odds ratio of low birth weight among those women aged 19 – 35 is 1.29. This means that there is a 29% increase in the probability of low birth weight for women aged 19-35 as compared with those aged 18 or less. In the same vein, the odds ratio for women aged more than 35 is 1.66, which means that there is a 66% increase in the probability of low birth weight for that group compared with those aged 18 years or less.

Regarding maternal education, women with a graduate degree were considered a reference. While the unadjusted odds ratios of low birth weight among women with a college degree or less and those undergraduates compared with graduates were all statistically significant, this was no longer the case for the adjusted odds ratios. This means that when other factors are accounted for, maternal education is no longer a predictor of low birth weight.

Compared with White women, Black Americans were about 57% more likely to deliver low birth weight babies while American Indians and Alaskan natives were 24% less likely. The data also showed that the odds ratio of low birth weight for Asian or Pacific Islander women was not statistically significant when compared with White women.

On maternal risk factors, high BMI (overweight) and 10 or more kg weight gain present odds ratios that were below 1 (0.66 and 0.57 respectively) and statistically significant compared with their respective reference categories. This means that women with high BMI were 34% less likely to give birth to an underweight child compared with those of normal weight while those who gain 10 kg or more were 43% less likely to give birth to an underweight child compared with those who gained less than 10 kg.

The data also show that participating in a WIC nutrition program results in a lower risk of low birth weight. In terms of pregnancy risk factors, women with congenital anomalies were three times more likely to give birth to an underweight child compared with those with no congenital anomalies. Women with pre-pregnancy diabetes were 22% less likely to give birth to an underweight child and those compared with women without pre-pregnancy diabetes. Also, women with pre-pregnancy hypertension were more than twice more likely to give birth to an underweight child compared with women with no pre-pregnancy hypertension.

Regarding the source of payment for the pregnancy and delivery care, we selected Medicaid as the reference group. The data, using both unadjusted and adjusted results, show that women with private insurance are 15% less likely to give birth to an underweight child compared with those under Medicaid. The corresponding figure for women who paid by themselves was 34%.

In terms of the infant's characteristics, the data reveal that male infants were 28% less likely to be born underweight compared with females. In addition, children with an APGAR score above 7 were 2.23 times more likely to be underweight compared with those with an APGAR score of 7 or less.

Discussions

Low birth weight defined, as a child's birth weight lower than 2500 grams, is the leading cause of newborns' mortality and morbidity. It is widely accepted that prenatal care is of value to both mother and child. However, there is still controversy over the effectiveness of prenatal care in preventing low birth weight because of difficulties in defining what constitutes prenatal care and adequate prenatal care use (Alexander and Korenbrot, 1995). This study examines the relationship between the number of prenatal visits and low birth weight among children born in the United States in 2017.

On prevalence: overall, 8,3% of all children in the sample were considered to be low birth weight. This finding was compatible with estimates from the World Health Organization & UNICEF (2019). In this global study, 8.0% of children born in the United States in 2015 were low birth weight, a level that has remained relatively stable over the past few decades.

On the relationship of LBW with the number of prenatal visits: Our study did not evaluate the contents or quality of prenatal care but only the number of visits. We found a significant and inverse relationship between the number of prenatal visits and low birth weight. As the number of prenatal visits increases, the probability of LBW reduces, even when other factors are accounted for. This means that, independently of the contents and quality of prenatal care, pregnant women need to be encouraged to present to as many prenatal visits as possible during their pregnancy. Similar findings emerged from a study by Pinzón-Rondón et al. (2015) in Columbia, even after controlling for content and quality of prenatal care.

On the relationship with prematurity: it is known that premature children (defined as birth before 37 weeks of gestational age) are usually born with a birth weight that is under 2500 grams. Our data confirm this observation even after controlling for other covariates.

On the relationship with multiple births: As with prematurity, it is expected that single births would be much less likely than multiple births to have low birth weight. A study by Child Trends (2016), using data from several databases including the CDC and the NCHS from 1977 to 2016, found that six percent of infants from singleton births had low birth weight, compared with 57 percent of infants from multiple births. In our study, 6.6% of singleton infants were low birth weight compared with 56.4% for multiple births. The independent impact of plurality on birth weight is confirmed through our multiple regression analysis, given that the adjusted odds ratio for multiple births was 11 when compared with singleton births.

On other covariates: the key findings from the analyses of other factors are as follows:

Mother's education, significantly associated with low birth weight in a bivariate analysis is no longer a predictor once other factors are accounted for;

As the mother's age increases, the probability of low birth weight increases. This finding is not totally in accordance with expectations. In a review of over fifty publications that examined the relationship between mother's age and low birth weight, Aras (2013) concluded that with the exception of a few studies which concluded that age did not significantly affect the birth weight of newborns, the majority of research indicated that a very young and old maternal age are causally implicated with an increased risk of having LBW. Results of multivariate analysis showed a U-shaped relationship between maternal age and LBW, with the youngest (younger than 15) and the oldest (aged 40 and older) mothers being at high risk than 25-29 years old;

Mother's race: this study confirms findings from others such as the Child Trends data on the relationship between race and low birth weight. Black mothers are more likely to deliver lower birth weight infants than White mothers. On the contrary, mothers that are American Indian or Alaskan natives are less likely to deliver infants with low birth weight even when all other factors are accounted for.

BMI and weight gain: Higher body-mass index is indicative of obesity while increased weight gain may also result in temporary obesity. Our findings indicate that both conditions are conducive to birth weights that are higher than 2500 g. This is compatible with other studies such as those by Liu et al. (2019) in China or Gondwe et al. (2018) in Malawi.There is no definitive conclusion about the importance of the source of payment for the costs of prenatal care (Anum et al., 2010). This study found that mothers with private insurance or those who paid for prenatal care by themselves were less likely to deliver low birth weight infants compared with mothers on Medicaid.

In terms of pregnancy risk factors, congenital anomalies and pre-pregnancy hypertension by the mother increase the risk of low birth weight infants. On the contrary, pre-pregnancy diabetes was associated with a lower risk of lower birth weight, a result that was compatible with the notion that diabetic mothers usually give birth to overweight infants.

Some unexpected findings from this study were related to the gender-low birth weight association as well as the negative correlation with the five-minute APGAR score. In a study of about 400 infants born in Jimma University Medical Center, Southwest Ethiopia, Getachew et al. (2020) found that lower five-minute APGAR scores were correlated with a higher risk of low birth weight. This finding was more intuitive as low birth weight would be more indicative of less vitality for the newborn.

Limitations of the Study

The study demonstrated a statistically significant association between prenatal visits and low birth weight. However, because of the use of a cross-sectional database, the study design could not allow making cause to effect inferences.

Future Studies

Further studies could be done to investigate the importance of the quality and the contents of antenatal care in reducing the prevalence of low birth weight and also examine other risk factors of low birth weight.

Conclusion

This study examined the association between the number of prenatal visits and low birth weight. Based on data available at the Centers for Disease Control and Prevention (CDC), we derived birth registration and prenatal visit information from a large population-based dataset of children born in 2017. The analyses of these data using multiple logistic regressions reveal that the number of prenatal visits has an inverse relationship with birth weight, even when confounding and other factors were accounted for. Although the contents and quality of prenatal care were not used in these analyses, these findings were compatible with the notion that the more a woman goes for prenatal visits, the more likely it is to detect any potential issue that may increase the risk of negative pregnancy outcome.

Declarations

Disclosure of potential conflicts of interest

We declare no conflicts of interest

Research involving human participants and/or animals

Not applicable

Informed Consent

Not applicable

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Data Availability

Data was accessed from the CDC free access file in SPSS format. Available from https://www.cdc.gov/nchs/data_access/vitalstatsonline.htm and https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/DVS/natality/UserGuide2017.pdf.

Code Availability

CDC Code book User guide to the 2017 Natality Public use file was accessed from https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/DVS/natality/UserGuide2017.pdf.

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Tables

Table 1. Descriptive analysis of birth weight, number of prenatal visits, and other selected covariates for CDC's 2017 Natality data (N=3,864,754)

Variables	Frequency (Percentage)
Birth weight	
Normal birth weight	3,545,327 (91.7)
Low birth weight	319,427 (8.3)
Independent Variable	
Number of prenatal visits	
No visit	66,824 (1.8)
10 or less	1,431,577 (38.0)
More than 11	2,268,367 (60.2)
Confounders	
Plurality	
Singleton Pregnancy	3,732,218 (96.6)
Multiple Pregnancy	132,536 (3.4)
Gestational Age	
37 weeks and higher	3,412,937 (88.4)
Less than 37 weeks	448,989 (11.6)
Covariates: Maternal characteristics	
Mother's Age	
18 and below	104,908 (2.7)
19-35	3,079,031 (79.7)
More than 35	680,815 (17.6)
Maternal Education	
College and less	2,262,739 (59.3)
Undergraduate	1,093,781 (28.7)
Graduate	458,447 (12.0)
Mother's Race	
1 White	772,280 (73.7)
2 Black	155,042 (14.8)
3 American Indian or Alaskan Native	127,33 (1.2)
4 Asian or Pacific Islander	108,521 (10.3)
Paternity Acknowledged	
No	392,369 (29.0)
Yes	962,388 (71.0)
BMI	
Less than 25	1,759,515 (45.5)
25 and more	2,105,239 (54.5)
Weight gain	
10 Kg or less	364,557 (9.4)
10 Kg and more	3,500,197 (90.6)
Covariates: Pregnancy history and prenatal care characteristics	
Parity	
Primipara	1,470,383 (38.0)
Multipara	2,394,371 (62.0)
WIC	
No	2,366,493 (62.0)
Yes	1,453,053 (38.0)
Covariates: Pregnancy risk factors	
No Congenital Anomalies	
No	13,405 (0.3)

Yes	3,846,412 (99.7)
Pre-Pregnancy Diabetes	
No	3,615,923 (93.7)
Yes	245,045 (6.3)
Pre-Pregnancy Hypertension	
No	3,612,346 (93.6)
Yes	248,622 (6.4)
Covariates: Delivery characteristics	
Payment method	
Medicaid	1,648,323 (42.9)
Private insurance	1,882,268 (49.1)
Self-paid	163,242 (4.25)
Other	147,445 (3.83)
Covariates: Infant characteristics	
Gender	
Female	1,887,091 (48.8)
Male	1,977,663 (51.2)
Five minutes APGAR	
7 and below	3,699,169 (96.1)
Above 7	150,849 (3.9)

Table 2: Bivariate analysis of the association between low birth weight and selected predictor variables (CDC 2017 Natality data – N=3,864,754)

Variables	Low Birth Weight N (%)	Normal Birth Weight N (%)	P-Value
Independent variable			
mber of prenatal visits			0.01
visit	13,013 (19.5)	53,811 (80.5)	
or less	172,857 (12.1)	1,258,720 (87.9)	
ore than 11	119,814 (5.3)	2,148,553 (94.5)	
Covariates: Maternal characteristics			
other's Age			0.01
and below	10,565 (10.1)	94,343 (89.9)	
-35	245,531 (8.0)	2,833,500 (92.0)	
ore than 35	63,331 (9.3)	617,484 (90.7)	
aternal Education			0.01
llege and less	207,032 (9.1)	2,055,707 (90.9)	
dergraduate	75,793 (6.9)	1,017,988 (93.1)	
aduate	31,306 (6.8)	427,141 (93.2)	
other's Race			0.01
ite	53,474 (6.9)	718,806 (93.1)	
ack	20,143 (13.0)	134,899 (87.0)	
erican Indian or Alaskan Native	989 (7.8)	11,744 (92.2)	
ian or Pacific Islander	8,529 (7.9)	99,992 (92.1)	
ternity Acknowledged			0.01
	51,619 (13.2)	340,750 (86.8)	
s	91,555 (9.5)	870,833 (90.5)	
MI			0.002
ss than 25	146,269 (8.3)	1,613,246 (91.7)	
and more	173,158 (8.2)	1,932,081 (91.8)	
eight gain			0.01
Kg or less	48,888 (13.4)	315,669 (86.6)	
Kg and more	270,539 (7.7)	3,229,658 (92.3)	
Covariates: Pregnancy history and prenatal care characteristics			
rity			0.01
mipara	130,299 (8.9)	1,340,084 (91.1)	
ltipara	189,128 (7.9)	2,205,243 (92.1)	
C			0.01
	182,409 (7.7)	2,184,084 (92.3)	
s	132,116 (9.1)	1,320,937 (90.9)	
Covariates: Pregnancy risk factors			
Congenital Anomalies			0.01
	3,562 (26.6)	9,843 (73.4)	
s	314,875 (8.2)	3,531,537 (91.8)	
e Pregnancy Diabetes			0.01
	296,552 (8.2)	3,319,371 (91.8)	
s	22,443 (9.2)	222,602 (90.8)	
e Pregnancy Hypertension			0.01
	270,550 (7.5)	3,341,796 (92.5)	
s	48,445 (19.5)	200,177 (80.5)	
Covariates: Delivery characteristics			

yment Recode			0.01
edicaid	159,959 (9.7)	1,488,364 (90.3)	
ivate insurance	134,554 (7.1)	1,747,714 (92.9)	
lf-paid	11,301 (6.9)	151,941 (93.1)	
her	11,505 (7.8)	135,940 (92.2)	
Covariates: Infant characteristics			
nder			0.01
male	169,013 (9.0)	1,718,078 (91.0)	
ale	150,414 (7.6)	1,827,249 (92.4)	
ve minutes APGAR			0.01
and below	26,5102 (7.2)	3,434,067 (92.8)	
ove 7	51,311 (34.0)	99,538 (66.0)	
Confounders			
urality			0.01
ngleton birth	244,615 (6.6)	3,487,603 (93.4)	
ultiple births	74,812 (56.4)	57,724 (43.6)	
stational Age			0.01
weeks and higher	111,116 (3.3)	3,301,821 (96.7)	
ss than 37 weeks	207,954 (46.3)	241,035 (53.7)	

Table 3: Unadjusted and Adjusted odds ratios of the relationship between the number of prenatal visits and low birth weight, adjusted for confounders and covariates (CDC 2017 Natality Data N=3,864,754)

Variables	Unadjusted OR (95% CI)	Adjusted OR (95%CI)
Independent variable		
Number of prenatal visits		
No visit =0	4.34 (4.25-4.42)	2.40 (2.23-2.60)
10 or less=1	2.46 (2.44-2.48)	1.74 (1.68-1.80)
More than 11=2	1	1
Confounders		
Plurality		
Singleton birth	1	1
Multiple births	18.48 (18.27-18.69)	11.12 (10.42-11.86)
Gestational age		
37 weeks and higher=0	1	1
Less than 37 weeks (Premature)	25.64 (25.43-25.85)	11.75 (11.36-12.14)
Covariates: Maternal characteristics		
Mother's Age		
18 and below	1	1
19-35	1.10 (1.07-1.12)	1.29 (1.20-137)
More than 35	0.85 (0.84-0.85)	1.66 (1.52-1.81)
Maternal Education		
College and less	1.37 (1.36-1.39)	1.11 (0.99-1.26)
Undergraduate	1.02 (1.00-1.03)	1.03 (0.90-1.17)
Graduate	1	1
Mother's Race		
White	1	1
Black	2.01 (1.97-2.04)	1.57 (1.52-1.62)
American Indian or Alaskan Native	1.13 (1.06-1.21)	0.76 (0.68-0.85)
Asian or Pacific Islander	1.15 (1.12-1.17)	0.91 (0.80-1.04)
Paternity Acknowledged		
No	1.44 (1.42-1.46)	1.10 (1.04-1.12)
Yes	1	1
Covariates: Maternal risk factors		
BMI		
Less than 25	1	1
25 and more	0.90 (0.98-1.00)	0.66 (0.64-0.69)
Weight gain		
10 Kg or less	1	1
10 Kg and more	0.54 (0.54-0.55)	0.57 (0.54-0.60)
Covariates: Pregnancy history and prenatal care characteristics		
Parity		
Primipara	1.13 (1.13-1.14)	1.410 (1.36-1.46)
Multipara	1	1
WIC		
No	1	1
Yes	1.20 (1.19-1.21)	0.94 (0.91-0.98)
Covariates: Pregnancy risk factors		
No Congenital Anomalies		
No	4.05 (3.91-4.22)	3.02 (2.44-3.74)

Yes	1	1
Pre Pregnancy Diabetes		
No	1	1
Yes	1.13 (1.11-1.15)	0.78 (0.72-0.85)
Pre Pregnancy Hypertension		
No	1	1
Yes	2.99 (2.96-3.02)	2.10 (2.00-2.21)
Covariates: Delivery characteristics		
Payment source		
Medicaid	1	1
Private insurance	0.72 (0.71-0.72)	0.85 (0.81-0.89)
Self-paid	0.69 (0.68-0.71)	0.66 (0.61-0.73)
Other	0.79 (0.77-0.80)	0.93 (0.84-1.03)
Covariates: Infant characteristics		
Gender		
Female	1	1
Male	0.84 (0.83-0.84)	0.72 (0.69-0.74)
Five minutes APGAR		
7 and below	1	1
Above 7	6.68 (6.60-6.75)	3.23 (3.07-3.41)

Figures

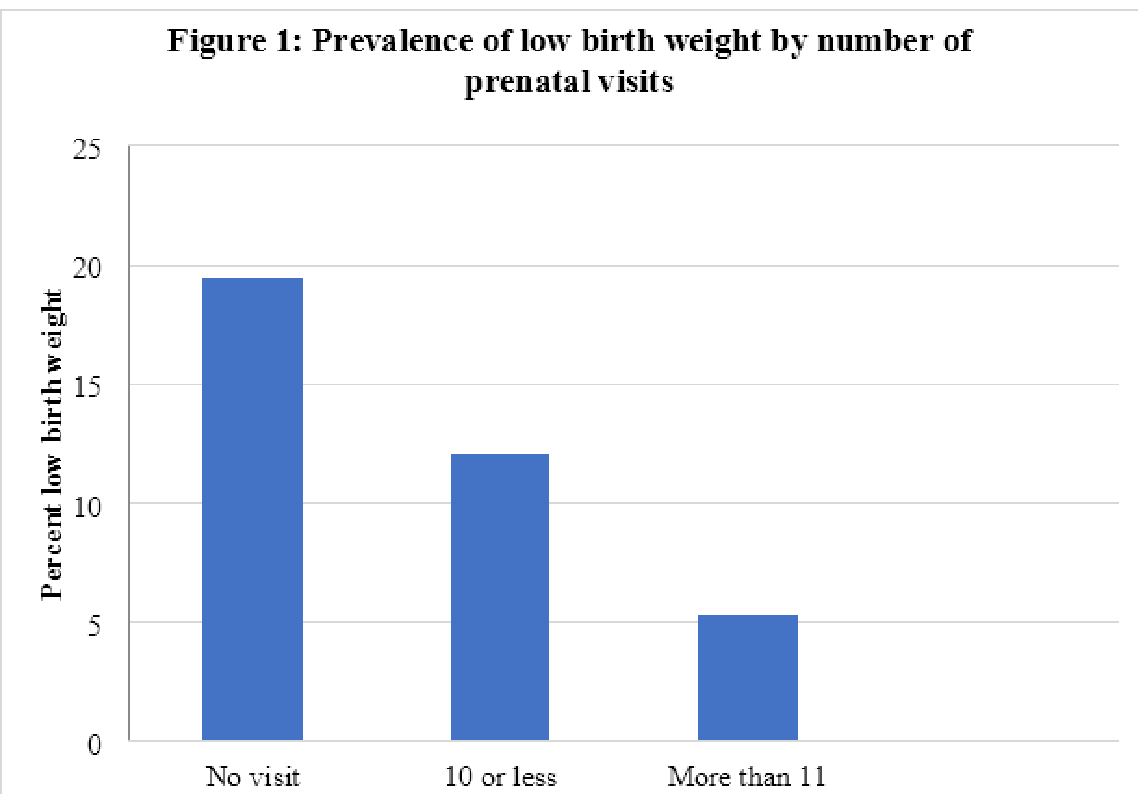

Figure 1

Prevalence of low birth weight by number of prenatal visits