

Effect of Interpregnancy Interval on Perinatal Outcomes in Michigan, 2008-2016

Prepared by
Michigan Department of Health and Human Services (MDHHS)
Maternal Child Health (MCH) Epidemiology Section
Data source: Michigan Resident Live Birth Files,
Division for Vital Records and Health Statistics, MDHHS
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This presentation provides information about the effect of interpregnancy interval on perinatal outcomes in Michigan, 2008-2016.

This presentation was prepared by the Michigan Department of Health and Human Services (MDHHS), Maternal and Child Health Epidemiology Section

Data source: Michigan resident live birth files, Division for Vital Records and Health Statistics, MDHHS

Revised: January 2019

Background

- Previous literature shows some associations between interpregnancy interval and adverse perinatal outcomes (*Khoshnood et al, 1998; James et al, 1999; Klebanoff, 1999; Shults et al, 1999; Zhu et al, 1999; Zhu et al, 2001*).
- Methodologic difficulties and a lack of statistical power have prevented those studies from concluding whether the association is due to confounding by other maternal risk factors (*Klebanoff, 1999; Shults et al, 1999*).
- Little information is available on the associations between interpregnancy interval and perinatal outcomes by maternal race among Michigan mothers using recent data.

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This slide details the background of the study that was conducted. This study is an update to the study of Zhu et al. (2001) which used data from 1993 to 1998.

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Methodologic difficulties and a lack of statistical power have prevented those studies from concluding whether the association is due to confounding by other maternal risk factors (*Klebanoff, 1999; Shults et al, 1999*).

Little information is available on the associations between interpregnancy interval and perinatal outcomes by maternal race among Michigan mothers using recent data.

Objective & Hypothesis

- Objective:
 - This study assessed the effect of interpregnancy interval on perinatal outcomes (preterm birth, low birthweight, and small-for-gestational-age birth) among Michigan white and black women, after controlling for maternal risk factors.
 - This study is an update of the Zhu et al. (2001)* study using the Michigan data from 2008 to 2016.
- Hypothesis:
 - A short or long interpregnancy interval is associated with higher risk of adverse perinatal outcomes after controlling for maternal risk factors.

* Zhu BP, Haines KM, Thu L, McGrath-Miller K, Boulton M. Effect of the interval between pregnancies on perinatal outcomes among white and black women. Am J Obstet Gynecol 2001;185(6):1403-10.

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This slide details the objective and hypothesis of this study.

The objective of this study is to assess the effect of interpregnancy interval on perinatal outcomes (preterm birth, low birthweight, and small-for-gestational-age birth) among Michigan white and black women, after controlling for maternal risk factors. This study is an update to the Zhu et al. (2001)* study using Michigan data from 2008 to 2016.

The hypothesis of this study is that a short or long interpregnancy interval is associated with higher risk of adverse perinatal outcomes after controlling for maternal risk factors.

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Methods: Study Population and Data Source

- This study used Michigan birth certificate data for singleton infants who were born alive between 2008 and 2016 to Michigan resident women who previously had delivered at least 1 live infant.
- For this study, we excluded infants who were not born to white or black women, multiple births, infants born to women who were primigravid, and infants whose birth records had missing or implausible values for birth weight (<400 g or >6000 g) or gestational age (<20 weeks or >45 weeks), sex, or the interpregnancy intervals were not estimable.
- The remaining 498,796 infants constituted the study population.

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The remaining 498,796 infants constituted the study population.

Methods: Measures

- Live birth certificate records provided the following data: maternal race (white or black); age at delivery; marital status; education; adequacy of prenatal care; outcome of the preceding pregnancy; total number of previous pregnancies; tobacco or alcohol use during pregnancy; infant sex; birthweight; and estimated gestational week.
- Interpregnancy interval was estimated as the month difference between the delivery date of the preceding live birth and the conception date of the index pregnancy. The conception date was estimated by the date of last menstrual period. If the day part of the previous infant's birth date or the last menstrual period date was not available, we assumed it to be the 15th day of the month.

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This slide details the measures that were used in this study.

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Methods: Measures

- Preterm birth was defined as a birth of a baby less than 37 completed weeks of gestation. Based on a recommendation by the National Center for Health Statistics, we used the clinically estimated gestational age, which is based on ultrasonographic measurement of the fetus or the physical and neurologic examinations of the newborn.
- Low birthweight was defined as a birthweight of a baby less than 2,500 grams.
- Small-for-gestational-age birth was defined as a birth with birthweight <10th percentile of the referent population of U.S. newborns for the infant's gestational age and sex (Talge et al, 2014).

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Methods: Measures

- Interpregnancy interval was categorized as 0-5, 6-11, 12-17, 18-23, 24-59, 60-119, 120+ months.
- Based on the literature and the availability of information on the birth certificate, the following maternal risk factors were included in the analysis:
 - Maternal race (white, black);
 - Maternal age at delivery (10-19, 20-24, 25-29, 30-34, 35-39, ≥ 40 years);
 - Maternal education (<high school or GED, high school diploma or GED, some college, 4 or more years college);
 - Marital status (unmarried, married);
 - Outcome of preceding pregnancy (live, dead);
 - Total number of previous pregnancies (1, 2, 3, 4, 5, ≥ 6);
 - Prenatal care (adequate plus, adequate, intermediate, inadequate);
 - Tobacco use during pregnancy (yes, no);
 - Alcohol use during pregnancy (yes, no).

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This slide also details the measures that were used in this study.

Interpregnancy interval was categorized as 0-5, 6-11, 12-17, 18-23, 24-59, 60-119, 120+ months.

Based on the literature and the availability of information on the birth certificate, the following maternal risk factors were included in the analysis:

- Maternal race (white, black);
- Maternal age at delivery (10-19, 20-24, 25-29, 30-34, 35-39, ≥ 40 years);
- Maternal education (<high school or GED, high school diploma or GED, some college, 4 or more years college);
- Marital status (unmarried, married);
- Outcome of preceding pregnancy (live, dead);
- Total number of previous pregnancies (1, 2, 3, 4, 5, ≥ 6);
- Prenatal care (adequate plus, adequate, intermediate, inadequate);
- Tobacco use during pregnancy (yes, no);
- Alcohol use during pregnancy (yes, no).

Methods: Statistical Analysis

- Distribution of selected maternal risk factors were measured between interpregnancy interval groups using percentages among multiparous women in Michigan who delivered a singleton live infant between 2008 and 2016.
- For each racial group, we stratified the data according to levels of the risk factors and examined the prevalence of adverse perinatal outcomes in relation to the interpregnancy interval.
- We also fit a separate logistic regression model for each of the adverse perinatal outcomes to simultaneously control for all other maternal risk factors. Each model included interpregnancy interval and all the maternal risk factors, categorized as design variables.
- Adjusted odds ratios (OR) and 95% confidence intervals (95% CI) were calculated using SAS, version 9.4.

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This slide details the statistical analyses that were used in this study.

The distributions of selected maternal risk factors were measured between interpregnancy interval groups using percentages among multiparous women in Michigan who delivered a singleton live infant between 2008 and 2016.

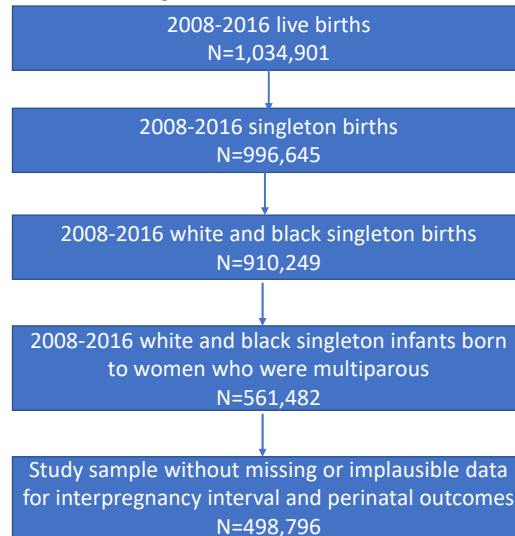
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Results

Figure 1. Flow chart for the study sample among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016



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This slide shows a flow chart for the study sample among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

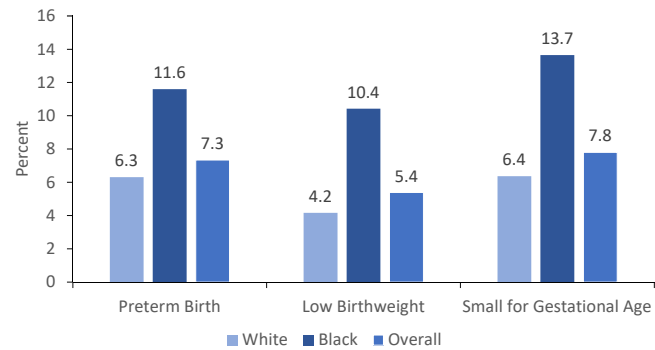
There were 1,034,901 live births in Michigan from 2008 to 2016. 996,645 live births were singleton. 910,249 live births were white and black singleton births. There were 561,482 white and black singleton infants born to women who were multiparous. After excluding missing or implausible data for interpregnancy interval and perinatal outcomes, the final study sample consisted of 498,796 multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

Results

- Of the infants born to white women, 6.3% were premature, 4.2% had low birth weight, and 6.4% were small for gestational age.
- In comparison, 11.6%, 10.4%, and 13.7% of the infants born to black women had the three adverse perinatal outcomes, respectively.
- Overall, 7.3% of the infants were premature, 5.4% had low birth weight and 7.8% were small for gestational age.

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Figure 2. Incidence of adverse perinatal outcomes by maternal race, Michigan, 2008-2016



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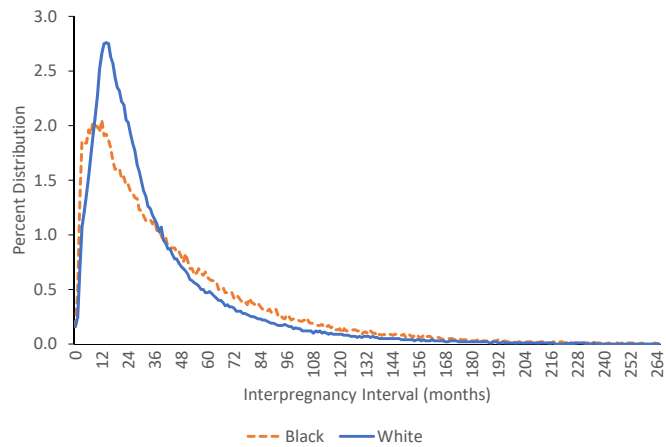
Results

Figure 3. Distribution (%) of the interpregnancy interval among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

- The distribution of interpregnancy interval for both white and black women was positively skewed.
- The median interpregnancy interval was 25.0 months for white, 31.0 months for black women, and 26.0 months for all women.
- Extreme interpregnancy intervals were more common among black women than among white women; 7.5% of black women (vs 4.7% of white women) had interpregnancy intervals of <6 months, and 6.0% of black women (vs 3.3% of white women) had interpregnancy intervals of ≥ 120 months.

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Figure 3. Distribution (%) of the interpregnancy interval among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016



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Extreme interpregnancy intervals were more common among black women than among white women; 7.5% of black women (vs 4.7% of white women) had interpregnancy intervals of <6 months, and 6.0% of black women (vs 3.3% of white women) had interpregnancy intervals of ≥ 120 months.

Results

Table 1. Distribution (%) of selected maternal risk factors according to interpregnancy interval among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

	Interpregnancy Interval (months)						
	0-5	6-11	12-17	18-23	24-59	60-119	≥120
Race							
White	4.7	12.1	16.1	13.6	36.8	13.4	3.4
Black	7.5	11.9	11.2	9.3	34.8	19.1	6.1
Age (years)							
10-19	21.3	26.1	20.1	12.2	19.7	*	*
20-24	10.4	17.5	16.8	13.4	37.4	4.5	*
25-29	5.0	12.5	15.5	12.8	37.4	15.9	0.8
30-34	3.0	9.6	15.6	13.6	36.9	16.6	4.6
35-39	2.4	7.9	11.8	10.8	35.2	20.6	11.3
≥40	1.9	5.9	8.4	8.2	30.0	23.6	21.9
Education							
<High school or GED	9.6	14.5	13.6	10.6	34.0	14.2	3.4
High school diploma or GED	6.6	12.1	12.7	10.9	36.4	16.8	4.5
Some college	4.6	11.1	13.7	11.5	36.7	17.3	5.0
4 or more years college	2.6	11.9	20.2	17.2	37.2	8.8	2.2
Marital status							
Not Married	7.5	11.8	11.4	9.5	35.2	19.0	5.6
Married	4.0	12.1	17.4	14.6	37.1	11.9	3.0

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* Data were insufficient for analysis.

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This slide shows the distribution (percent) of selected maternal risk factors according to interpregnancy interval among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

Interpregnancy intervals of <6 months were more common among women who were younger (21.3% among women 10-19 years old; 10.4% among women 20-24 years old), had less than high school education (9.6%), and were not married (7.5%).

Interpregnancy intervals of ≥120 months were more common among women who were older (21.9% among women ≥40 years old; 11.3% among women 35-39 years old), were not married (5.6%).

Results

Table 1 (Continued). Distribution (%) of selected maternal risk factors according to interpregnancy interval among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

	Interpregnancy Interval (months)						
	0-5	6-11	12-17	18-23	24-59	60-119	≥120
Outcome of preceding pregnancy							
Live	5.7	12.8	16.1	13.2	35.7	13.1	3.3
Dead	4.3	10.4	13.0	11.7	37.9	17.5	5.2
Previous pregnancies (n)							
1	5.0	12.6	17.0	14.1	36.2	12.0	3.2
2	5.0	11.2	14.1	12.5	38.0	15.2	4.0
3	5.5	11.5	13.7	11.7	36.3	16.8	4.5
4	5.7	11.9	13.7	11.0	35.3	17.3	5.0
5	6.4	12.2	13.6	10.9	34.7	17.4	4.7
≥6	6.7	14.0	15.1	11.5	32.8	15.5	4.4
Prenatal care							
Adequate plus	4.2	10.6	14.2	12.5	37.6	16.2	4.7
Adequate	4.1	11.5	15.9	13.6	37.5	13.9	3.5
Intermediate	5.7	12.8	15.7	13.0	35.7	13.9	3.2
Inadequate	11.0	16.8	15.4	10.9	30.3	12.3	3.3

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This slide shows the distribution (percent) of additional maternal risk factors according to interpregnancy interval among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

Interpregnancy intervals of <6 months were more common among women who had a previous pregnancy that resulted in a live birth (5.7%), had a higher total number of previous pregnancies (6.7% among women who had ≥6 previous pregnancies), and had inadequate prenatal care (11.0%).

Interpregnancy intervals of ≥120 months were more common among women who had a previous pregnancy that resulted in a stillbirth or fetal death (5.2%), or had adequate plus prenatal care (4.7%).

Results

Table 1 (Continued). Distribution (%) of selected maternal risk factors according to interpregnancy interval among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

	Interpregnancy Interval (months)						
	0-5	6-11	12-17	18-23	24-59	60-119	≥120
Tobacco use during pregnancy							
Yes	6.6	11.0	11.3	10.0	36.1	19.4	5.7
No	4.9	12.3	16.2	13.5	36.5	13.2	3.4
Alcohol use during pregnancy							
Yes	5.7	11.9	13.1	10.0	35.9	17.5	5.9
No	5.3	12.0	15.2	12.8	36.4	14.5	3.9

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This slide shows the distribution (percent) of additional maternal risk factors according to interpregnancy interval among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

Interpregnancy intervals of <6 months were more common among women who were had used tobacco (6.6%) or alcohol (5.7%) during pregnancy.

Interpregnancy intervals of ≥120 months were more common among women who had used tobacco (5.7%) or alcohol (5.9%) during pregnancy.

Results

- The median interpregnancy interval was 25.0 months for white women, 31.0 months for black women, and 26.0 months for all women.
- The distribution of interpregnancy interval for both white and black women was positively skewed (Figure 3).
- Extreme interpregnancy intervals were more common among black women than among white women; 7.5% of black women (vs 4.7% of white women) had interpregnancy intervals of <6 months, and 6.0% of black women (vs 3.3% of white women) had interpregnancy intervals of ≥ 120 months.
- Interpregnancy intervals of <6 months were more common among women who were younger, had less than high school education, were not married, had a higher total number of previous pregnancies, had inadequate prenatal care, had a previous pregnancy that resulted in a live birth, and had used tobacco or alcohol during pregnancy (Table 1).
- Interpregnancy intervals of ≥ 120 months were more common among women who were older, were not married, had adequate plus prenatal care, had used tobacco or alcohol during pregnancy, or had a previous pregnancy that resulted in a stillbirth or fetal death (Table 1).

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This slide summarizes the results presented within the previous few slides.

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Interpregnancy intervals of <6 months were more common among women who were younger, had less than high school education, were not married, had a higher total number of previous pregnancies, had inadequate prenatal care, had a previous pregnancy that resulted in a live birth, and had used tobacco or alcohol during pregnancy (Table 1).

Interpregnancy intervals of ≥ 120 months were more common among women who were older, were not married, had adequate plus prenatal care, had used tobacco or alcohol

during pregnancy, or had a previous pregnancy that resulted in a stillbirth or fetal death (Table 1).

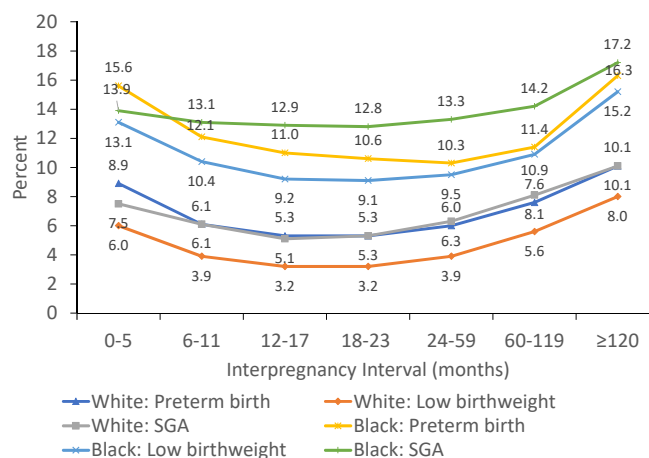
Results

Figure 4. Prevalence (%) of adverse perinatal outcomes according to the interpregnancy interval among white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

- A J-shaped relationship was observed between interpregnancy interval and the 3 adverse perinatal outcomes among both white and black women.
- The risk for all 3 adverse perinatal outcomes was high if the interpregnancy interval was <6 months.
- The risk declined as the interval increased and reached the lowest level when the interpregnancy interval was between 18 and 23 months.
- For interpregnancy intervals of ≥ 24 months, the risk for adverse perinatal outcomes gradually increased.

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For interpregnancy intervals of ≥ 24 months, the risk for adverse perinatal outcomes gradually increased.

Results

Table 2. Prevalence (%) of preterm birth according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

	Interpregnancy Interval (months)						
	0-5	6-11	12-17	18-23	24-59	60-119	≥120
Race							
White	8.9	6.1	5.3	5.3	6.0	7.6	10.1
Black	15.6	12.1	11.0	10.6	10.3	11.4	16.3
Age (years)							
10-19	14.5	11.1	10.0	8.9	8.9	*	*
20-24	11.4	8.5	7.5	7.5	7.7	8.6	*
25-29	9.6	6.4	5.9	5.7	6.6	7.9	12.0
30-34	9.6	6.1	5.2	5.3	6.2	8.5	10.6
35-39	10.7	7.8	6.3	6.4	7.1	9.2	12.7
≥40	12.7	6.0	6.5	5.3	8.6	10.8	13.1
Education							
<High school or GED	12.7	10.2	8.2	8.9	8.8	9.7	15.0
High school diploma or GED	12.2	8.4	7.9	7.2	7.9	8.9	12.1
Some college	9.4	6.8	6.3	6.1	6.6	8.3	11.7
4 or more years college	6.3	4.7	4.3	4.3	5.2	7.6	10.0
Marital status							
Not Married	12.8	10.0	9.2	8.7	8.7	9.4	13.3
Married	8.6	5.7	5.0	5.0	5.8	7.8	10.4

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* Data were insufficient for analysis.

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This slide shows the prevalence (percent) of preterm birth according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

The risk for preterm birth was high if the interpregnancy interval was <6 months (8.9%, 15.6% among White or Black women; 14.5%, 11.4%, 9.6%, 9.6%, 10.7%, 12.7% among different age groups; 12.7%, 12.2%, 9.4%, 6.3% among different education groups; 12.8%, 8.6% among not married or married women).

The risk for preterm birth declined as the interval increased and reached the lowest level when the interpregnancy interval was between 18 and 23 months.

For interpregnancy intervals of ≥24 months, the risk for preterm birth gradually increased.

The risk for preterm birth was high if the interpregnancy interval was ≥120 months (10.1%, 16.3% among White or Black women; 12.0%, 10.6%, 12.7%, 13.1% among different age groups over 24 years old; 15.0%, 12.1%, 11.7%, 10.0% among different education groups; 13.3%, 10.4% among not married or married women).

When the data was stratified by the risk factors, a J-shaped relationship between the

interpregnancy interval and preterm birth was observed wherever the data supported the stratified analyses.

Results

Table 2 (Continued). Prevalence (%) of preterm birth according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

	Interpregnancy Interval (months)						
	0-5	6-11	12-17	18-23	24-59	60-119	≥120
Outcome of preceding pregnancy							
Live	10.3	6.9	5.7	5.6	6.3	8.0	11.0
Dead	12.2	8.3	7.4	7.1	7.9	9.5	13.3
Previous pregnancies (n)							
1	9.0	6.0	5.2	4.9	6.0	7.5	10.2
2	10.4	6.8	5.7	5.7	6.1	7.9	11.1
3	11.2	7.7	7.0	6.7	7.6	8.7	12.8
4	12.3	9.1	8.0	8.7	8.5	9.5	14.7
5	14.9	11.2	8.8	8.8	9.6	11.1	15.5
≥6	16.2	11.5	9.9	9.8	10.8	13.8	15.9
Prenatal care							
Adequate plus	16.0	11.6	10.5	10.2	11.2	13.3	17.5
Adequate	5.1	2.8	2.4	2.2	2.6	3.3	4.6
Intermediate	7.0	4.2	3.3	3.8	4.0	4.8	7.3
Inadequate	12.6	9.4	7.8	8.0	8.7	10.3	14.6

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This slide is a continuation of the previous slide and shows the prevalence (percent) of preterm birth according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

The risk for preterm birth was high if the interpregnancy interval was <6 months (10.3%, 12.2% among women who had a previous pregnancy that resulted in a live birth or a stillbirth or fetal death; 9.0%, 10.4%, 11.2%, 12.3%, 14.9%, 16.2% among different numbers of previous pregnancies groups; 16.0%, 5.1%, 7.0%, 12.6% among different prenatal care groups).

The risk for preterm birth declined as the interval increased and reached the lowest level when the interpregnancy interval was between 18 and 23 months.

For interpregnancy intervals of ≥24 months, the risk for preterm birth gradually increased.

The risk for preterm birth was high if the interpregnancy interval was ≥120 months (11.0%, 13.3% among women who had a previous pregnancy that resulted in a live birth or a stillbirth or fetal death; 10.2%, 11.1%, 12.8%, 14.7%, 15.5%, 15.9% among different numbers of previous pregnancies groups; 17.5%, 4.6%, 7.3%, 14.6% among different

prenatal care groups).

When the data was stratified by the risk factors, a J-shaped relationship between the interpregnancy interval and preterm birth was observed wherever the data supported the stratified analyses.

Results

Table 2 (Continued). Prevalence (%) of preterm birth according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

	Interpregnancy Interval (months)						
	0-5	6-11	12-17	18-23	24-59	60-119	≥120
Tobacco use during pregnancy							
Yes	12.8	10.1	8.8	8.2	8.4	9.1	12.8
No	10.0	6.5	5.6	5.6	6.4	8.3	11.5
Alcohol use during pregnancy							
Yes	15.3	10.3	9.3	11.1	9.4	13.5	16.9
No	10.7	7.2	6.1	6.0	6.8	8.5	11.9

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This slide is a continuation of the previous two slides and shows the prevalence (percent) of preterm birth according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

The risk for preterm birth was high if the interpregnancy interval was <6 months (12.8%, 10.0% among women who smoked or did not smoke during pregnancy; 15.3%, 10.7% among who used or did not use alcohol during pregnancy).

The risk for preterm birth declined as the interval increased and reached the lowest level when the interpregnancy interval was between 18 and 23 months.

For interpregnancy intervals of ≥24 months, the risk for preterm birth gradually increased.

The risk for preterm birth was high if the interpregnancy interval was ≥120 months (12.8%, 11.5% among women who smoked or did not smoke during pregnancy; 16.9%, 11.9% among who used or did not use alcohol during pregnancy).

When the data was stratified by the risk factors, a J-shaped relationship between the interpregnancy interval and preterm birth was observed wherever the data supported the

stratified analyses.

Results

Table 3. Prevalence (%) of low birthweight according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

	Interpregnancy Interval (months)						
	0-5	6-11	12-17	18-23	24-59	60-119	≥120
Race							
White	6.0	3.9	3.2	3.2	3.9	5.6	8.0
Black	13.1	10.4	9.2	9.1	9.5	10.9	15.2
Age (years)							
10-19	11.9	8.9	8.2	7.2	8.3	*	*
20-24	8.9	6.9	5.9	5.8	6.2	8.0	*
25-29	7.0	4.4	3.9	3.8	5.2	6.9	9.8
30-34	6.2	3.8	2.9	3.2	4.0	6.6	8.7
35-39	6.6	4.8	3.5	3.7	4.3	7.0	10.8
≥40	9.2	4.3	3.7	3.7	5.8	8.0	11.9
Education							
<High school or GED	10.7	8.8	7.1	7.3	8.0	9.4	14.6
High school diploma or GED	9.3	6.2	5.8	5.4	6.2	7.8	10.9
Some college	6.0	4.6	4.0	3.9	4.5	6.3	9.4
4 or more years college	3.6	2.4	2.1	2.3	2.9	4.9	7.4
Marital status							
Not Married	10.3	8.2	7.4	7.1	7.5	8.6	12.2
Married	5.4	3.4	2.8	2.9	3.5	5.4	8.0

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* Data were insufficient for analysis.

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This slide shows the prevalence (percent) of low birthweight according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

The risk for low birthweight was high if the interpregnancy interval was <6 months (6.0%, 13.1% among White or Black women; 11.9%, 8.9%, 7.0%, 6.2%, 6.6%, 9.2% among different age groups; 10.7%, 9.3%, 6.0%, 3.6% among different education groups; 10.3%, 5.4% among not married or married women).

The risk for low birthweight declined as the interval increased and reached the lowest level when the interpregnancy interval was between 18 and 23 months.

For interpregnancy intervals of ≥24 months, the risk for low birthweight gradually increased.

The risk for low birthweight was high if the interpregnancy interval was ≥120 months (8.0%, 15.2% among White or Black women; 9.8%, 8.7%, 10.8%, 11.9% among different age groups over 24 years old; 14.6%, 10.9%, 9.4%, 7.4% among different education groups; 12.2%, 8.0% among not married or married women).

When the data was stratified by the risk factors, a J-shaped relationship between the interpregnancy interval and low birthweight was observed wherever the data supported the stratified analyses.

Results

Table 3 (Continued). Prevalence (%) of low birthweight according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

	Interpregnancy Interval (months)						
	0-5	6-11	12-17	18-23	24-59	60-119	≥120
Outcome of preceding pregnancy							
Live	7.6	4.8	3.8	3.8	4.5	6.4	9.3
Dead	9.1	6.2	4.8	4.8	5.8	7.9	11.4
Previous pregnancies (n)							
1	6.7	4.2	3.4	3.3	4.3	6.2	8.8
2	7.8	4.6	3.8	4.0	4.4	6.3	9.1
3	8.2	5.6	4.7	4.0	5.5	6.8	10.8
4	8.4	6.8	5.6	5.8	6.5	8.0	11.9
5	10.9	8.4	5.8	5.8	6.8	9.5	12.7
≥6	12.1	8.6	6.8	7.2	8.1	10.9	16.4
Prenatal care							
Adequate plus	10.5	7.3	6.0	6.0	7.1	9.6	13.4
Adequate	4.1	2.4	2.0	1.8	2.4	3.5	5.0
Intermediate	5.5	3.4	2.5	2.9	3.4	4.6	6.4
Inadequate	10.2	7.1	6.1	6.5	7.2	9.2	14.3

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This slide is a continuation of the previous slide and shows the prevalence (percent) of low birthweight according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

The risk for low birthweight was high if the interpregnancy interval was <6 months (7.6%, 9.1% among women who had a previous pregnancy that resulted in a live birth or a stillbirth or fetal death; 6.7%, 7.8%, 8.2%, 8.4%, 10.9%, 12.1% among different numbers of previous pregnancies groups; 10.5%, 4.1%, 5.5%, 10.2% among different prenatal care groups).

The risk for low birthweight declined as the interval increased and reached the lowest level when the interpregnancy interval was between 18 and 23 months.

For interpregnancy intervals of ≥24 months, the risk for low birthweight gradually increased.

The risk for low birthweight was high if the interpregnancy interval was ≥120 months (9.3%, 11.4% among women who had a previous pregnancy that resulted in a live birth or a stillbirth or fetal death; 8.8%, 9.1%, 10.8%, 11.9%, 12.7%, 16.4% among different numbers

of previous pregnancies groups; 13.4%, 5.0%, 6.4%, 14.3% among different prenatal care groups).

When the data was stratified by the risk factors, a J-shaped relationship between the interpregnancy interval and low birthweight was observed wherever the data supported the stratified analyses.

Results

Table 3 (Continued). Prevalence (%) of low birthweight according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

	Interpregnancy Interval (months)						
	0-5	6-11	12-17	18-23	24-59	60-119	≥120
Tobacco use during pregnancy							
Yes	11.4	9.4	7.7	7.5	7.8	9.1	13.5
No	6.7	4.1	3.4	3.4	4.2	6.0	8.6
Alcohol use during pregnancy							
Yes	15.3	10.9	9.3	9.5	9.1	12.0	19.6
No	7.9	5.1	4.1	4.0	4.9	6.9	10.1

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22

This slide is a continuation of the previous two slides and shows the prevalence (percent) of low birthweight according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

The risk for low birthweight was high if the interpregnancy interval was <6 months (11.4%, 6.7% among women who smoked or did not smoke during pregnancy; 15.3%, 7.9% among who used or did not use alcohol during pregnancy).

The risk for low birthweight declined as the interval increased and reached the lowest level when the interpregnancy interval was between 18 and 23 months.

For interpregnancy intervals of ≥24 months, the risk for low birthweight gradually increased.

The risk for low birthweight was high if the interpregnancy interval was ≥120 months (13.5%, 8.6% among women who smoked or did not smoke during pregnancy; 19.6%, 10.1% among who used or did not use alcohol during pregnancy).

When the data was stratified by the risk factors, a J-shaped relationship between the

interpregnancy interval and low birthweight was observed wherever the data supported the stratified analyses.

Results

Table 4. Prevalence (%) of small-for-gestational-age birth according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

	Interpregnancy Interval (months)						
	0-5	6-11	12-17	18-23	24-59	60-119	≥120
Race							
White	7.5	6.1	5.1	5.3	6.3	8.1	10.1
Black	13.9	13.1	12.9	12.8	13.3	14.2	17.2
Age (years)							
10-19	12.1	11.7	11.2	10.2	13.8	*	*
20-24	10.5	9.9	9.6	9.9	10.2	12.5	*
25-29	8.9	6.8	6.1	6.4	8.3	10.5	11.6
30-34	7.0	5.6	4.5	4.5	5.8	9.2	12.1
35-39	7.1	5.7	4.5	4.8	5.9	8.5	12.3
≥40	8.5	5.1	4.4	5.6	7.0	9.1	13.2
Education							
<High school or GED	12.3	11.9	11.7	11.7	12.8	14.4	16.9
High school diploma or GED	10.5	9.3	8.6	8.8	9.5	11.0	13.5
Some college	7.6	6.7	5.8	5.9	6.8	8.7	11.7
4 or more years college	4.5	3.7	3.4	3.5	4.3	6.0	8.1
Marital status							
Not Married	11.5	11.3	11.0	11.1	11.3	12.1	14.8
Married	6.9	5.3	4.5	4.5	5.5	7.5	9.5

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* Data were insufficient for analysis.

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This slide shows the prevalence (percent) of small-for-gestational-age birth according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

The risk for small-for-gestational-age birth was high if the interpregnancy interval was <6 months (7.5%, 13.9% among White or Black women; 12.1%, 10.5%, 8.9%, 7.0%, 7.1%, 8.5% among different age groups; 12.3%, 10.5%, 7.6%, 4.5% among different education groups; 11.5%, 6.9% among not married or married women).

The risk for small-for-gestational-age birth declined as the interval increased and reached the lowest level when the interpregnancy interval was between 18 and 23 months.

For interpregnancy intervals of ≥24 months, the risk for small-for-gestational-age birth gradually increased.

The risk for small-for-gestational-age birth was high if the interpregnancy interval was ≥120 months (10.1%, 17.2% among White or Black women; 11.6%, 12.1%, 12.3%, 13.2% among different age groups over 24 years old; 16.9%, 13.5%, 11.7%, 8.1% among different education groups; 14.8%, 9.5% among not married or married women).

When the data was stratified by the risk factors, a J-shaped relationship between the interpregnancy interval and small-for-gestational-age birth was observed wherever the data supported the stratified analyses.

Results

Table 4 (Continued). Prevalence (%) of small-for-gestational-age birth according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

	Interpregnancy Interval (months)						
	0-5	6-11	12-17	18-23	24-59	60-119	≥120
Outcome of preceding pregnancy							
Live	9.1	7.5	6.2	6.2	7.3	9.3	11.5
Dead	9.9	7.5	6.6	6.7	8.1	10.5	13.5
Previous pregnancies (n)							
1	8.7	6.9	5.9	5.8	7.1	9.2	11.3
2	9.3	7.7	6.0	6.4	7.3	9.3	11.7
3	10.0	7.3	6.7	6.6	7.9	9.7	12.8
4	9.3	8.0	7.7	7.2	8.8	10.3	13.0
5	10.6	9.1	7.3	7.8	8.6	11.3	14.0
≥6	10.4	8.9	7.1	7.7	9.3	12.5	16.5
Prenatal care							
Adequate plus	9.0	7.3	6.1	6.5	7.6	9.8	12.3
Adequate	7.4	6.3	5.1	4.9	6.3	8.3	10.9
Intermediate	9.1	6.8	6.7	6.8	8.1	10.0	12.0
Inadequate	11.4	10.1	9.4	10.2	11.2	13.2	16.2

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This slide is a continuation of the previous slide and shows the prevalence (percent) of small-for-gestational-age birth according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

The risk for small-for-gestational-age birth was high if the interpregnancy interval was <6 months (9.1%, 9.9% among women who had a previous pregnancy that resulted in a live birth or a stillbirth or fetal death; 8.7%, 9.3%, 10.0%, 9.3%, 10.6%, 10.4% among different numbers of previous pregnancies groups; 9.0%, 7.4%, 9.1%, 11.4% among different prenatal care groups).

The risk for small-for-gestational-age birth declined as the interval increased and reached the lowest level when the interpregnancy interval was between 18 and 23 months.

For interpregnancy intervals of ≥24 months, the risk for small-for-gestational-age birth gradually increased.

The risk for small-for-gestational-age birth was high if the interpregnancy interval was ≥120 months (11.5%, 13.5% among women who had a previous pregnancy that resulted in a live birth or a stillbirth or fetal death; 11.3%, 11.7%, 12.8%, 13.0%, 14.0%, 16.5% among

different numbers of previous pregnancies groups; 12.3%, 10.9%, 12.0%, 16.2% among different prenatal care groups).

When the data was stratified by the risk factors, a J-shaped relationship between the interpregnancy interval and small-for-gestational-age birth was observed wherever the data supported the stratified analyses.

Results

Table 4 (Continued). Prevalence (%) of small-for-gestational-age birth according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

	Interpregnancy Interval (months)						
	0-5	6-11	12-17	18-23	24-59	60-119	≥120
Tobacco use during pregnancy							
Yes	14.5	13.2	12.6	12.5	13.0	14.7	17.6
No	7.4	6.1	5.1	5.1	6.1	7.7	9.8
Alcohol use during pregnancy							
Yes	10.4	13.6	10.2	11.5	12.1	16.0	22.3
No	9.3	7.4	6.2	6.3	7.6	9.7	12.2

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This slide is a continuation of the previous two slides and shows the prevalence (percent) of small-for-gestational-age birth according to interpregnancy interval and selected maternal risk factors among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016.

The risk for small-for-gestational-age birth was high if the interpregnancy interval was <6 months (14.5%, 7.4% among women who smoked or did not smoke during pregnancy; 10.4%, 9.3% among who used or did not use alcohol during pregnancy).

The risk for small-for-gestational-age birth declined as the interval increased and reached the lowest level when the interpregnancy interval was between 18 and 23 months.

For interpregnancy intervals of ≥24 months, the risk for small-for-gestational-age birth gradually increased.

The risk for small-for-gestational-age birth was high if the interpregnancy interval was ≥120 months (17.6%, 9.8% among women who smoked or did not smoke during pregnancy; 22.3%, 12.2% among who used or did not use alcohol during pregnancy).

When the data was stratified by the risk factors, a J-shaped relationship between the

interpregnancy interval and small-for-gestational-age birth was observed wherever the data supported the stratified analyses.

Results

- A J-shaped relationship was observed between interpregnancy interval and the three adverse perinatal outcomes among both white and black women (Figure 4).
- The risk for all three adverse perinatal outcomes was high if the interpregnancy interval was <6 months.
- The risk declined as the interval increased and reached the lowest level when the interpregnancy interval was between 18 and 23 months.
- For interpregnancy intervals of ≥ 24 months, the risk for adverse perinatal outcomes gradually increased.
- When the data was stratified by the risk factors, a J-shaped relationship between the interpregnancy interval and adverse perinatal outcomes was observed wherever the data supported the stratified analyses (Tables 2-4).

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This slide details additional summary results from this study that were included within the previous several slides.

A J-shaped relationship was observed between interpregnancy interval and the three adverse perinatal outcomes among both white and black women (Figure 4).

The risk for all three adverse perinatal outcomes was high if the interpregnancy interval was <6 months.

The risk declined as the interval increased and reached the lowest level when the interpregnancy interval was between 18 and 23 months.

For interpregnancy intervals of ≥ 24 months, the risk for adverse perinatal outcomes gradually increased.

When the data was stratified by the risk factors, a J-shaped relationship between the interpregnancy interval and adverse perinatal outcomes was observed wherever the data supported the stratified analyses (Tables 2-4).

Results

Table 5. Results of logistic regression analyses* of interpregnancy interval in relation to low birth weight, preterm birth, and small-for-gestational-age birth among multiparous white women in Michigan who delivered a singleton live infant between 2008 and 2016

Interpregnancy Interval (months)	Preterm Birth		Low Birthweight		Small for Gestational Age	
	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
White women						
0-5	1.5	(1.4, 1.6)	1.5	(1.4, 1.6)	1.1	(1.0, 1.1)
6-11	1.1	(1.0, 1.2)	1.1	(1.0, 1.2)	1.0	(1.0, 1.1)
12-17	1.0	(1.0, 1.1)	1.0	(0.9, 1.1)	1.0	(0.9, 1.0)
18-23	1.0		1.0		1.0	
24-59	1.1	(1.0, 1.1)	1.1	(1.0, 1.2)	1.1	(1.0, 1.1)
60-119	1.2	(1.1, 1.3)	1.4	(1.3, 1.4)	1.2	(1.2, 1.3)
≥120	1.5	(1.4, 1.7)	1.8	(1.6, 2.0)	1.5	(1.4, 1.6)

* Analyses were controlled for maternal age at delivery, marital status, education, adequacy of prenatal care, outcome of the preceding birth (live birth or still birth), total number of previous pregnancies, tobacco use during pregnancy, and alcohol use during pregnancy.

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This slide shows the results of the logistic regression analyses of interpregnancy interval in relation to low birth weight, preterm birth, and small-for-gestational-age birth among multiparous white women in Michigan who delivered a singleton live infant between 2008 and 2016. These analyses were controlled for maternal age at delivery, marital status, education, adequacy of prenatal care, outcome of the preceding birth (live birth or still birth), total number of previous pregnancies, tobacco use during pregnancy, and alcohol use during pregnancy.

When controlling for all maternal risk factors simultaneously using logistic regression, the J-shaped relationship between interpregnancy interval and adverse perinatal outcomes persisted overall and among white women.

Women who had interpregnancy intervals of 18 to 23 months were at the lowest risk for delivering infants with the three adverse perinatal outcomes.

Among white women, an interpregnancy interval of <6 months was associated with an odds ratio of 1.5 (95% CI, 1.4%-1.6%) for preterm birth, 1.5 (95% CI, 1.4%- 1.6%) for low birth weight, and 1.1 (95% CI, 1.0%-1.1%) for small-for-gestational-age birth. An interval of ≥120 months was associated with an odds ratio of 1.5 (95% CI, 1.4%-1.7%), 1.8 (95% CI, 1.6%-2.0%), and 1.5 (95% CI, 1.4%-1.6%) for the three adverse perinatal outcomes,

respectively, after controlling for other maternal risk factors.

A closer look at the results of the logistic regression analyses showed that, although in most instances the risk for adverse perinatal outcomes was lowest when the interpregnancy interval was between 18 and 23 months, the increase in the risk that is associated with interpregnancy intervals of 12 to 17 or 24 to 59 months was minimal. Only when the interval was excessively short (especially <6 months) or long (especially ≥ 120 months) did the risk increase appreciably.

Results

Table 6. Results of logistic regression analyses* of interpregnancy interval in relation to low birth weight, preterm birth, and small-for-gestational-age birth among multiparous black women in Michigan who delivered a singleton live infant between 2008 and 2016

Interpregnancy Interval (months)	Preterm Birth		Low Birthweight		Small for Gestational Age	
	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
Black women						
0-5	1.5	(1.3, 1.6)	1.4	(1.3, 1.6)	1.1	(1.0, 1.2)
6-11	1.1	(1.0, 1.2)	1.1	(1.0, 1.2)	1.0	(0.9, 1.1)
12-17	1.0	(0.9, 1.1)	1.0	(0.9, 1.1)	1.0	(0.9, 1.1)
18-23	1.0		1.0		1.0	
24-59	1.0	(0.9, 1.1)	1.0	(1.0, 1.1)	1.1	(1.0, 1.2)
60-119	1.1	(1.0, 1.2)	1.2	(1.1, 1.3)	1.2	(1.1, 1.3)
≥120	1.4	(1.3, 1.6)	1.5	(1.3, 1.7)	1.4	(1.3, 1.6)

* Analyses were controlled for maternal age at delivery, marital status, education, adequacy of prenatal care, outcome of the preceding birth (live birth or still birth), total number of previous pregnancies, tobacco use during pregnancy, and alcohol use during pregnancy.

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This slide shows additional results of the logistic regression analyses of interpregnancy interval in relation to low birth weight, preterm birth, and small-for-gestational-age birth among multiparous black women in Michigan who delivered a singleton live infant between 2008 and 2016. These analyses were controlled for maternal age at delivery, marital status, education, adequacy of prenatal care, outcome of the preceding birth (live birth or still birth), total number of previous pregnancies, tobacco use during pregnancy, and alcohol use during pregnancy.

When controlling for all maternal risk factors simultaneously using logistic regression, the J-shaped relationship between interpregnancy interval and adverse perinatal outcomes persisted overall and among black women.

Women who had interpregnancy intervals of 18 to 23 months were at the lowest risk for delivering infants with the three adverse perinatal outcomes.

Among black women, an interpregnancy interval of <6 months was associated with an odds ratio of 1.5 (95% CI, 1.3%-1.6%) for preterm birth, 1.4 (95% CI, 1.3%-1.6%) for low birth weight, and 1.1 (95% CI, 1.0%-1.2%) for small-for-gestational-age birth. An interval of ≥120 months was associated with an odds ratio of 1.4 (95% CI, 1.3%-1.6%), 1.5 (95% CI, 1.3%-1.7%), and 1.4 (95% CI, 1.3%-1.6%) for the three adverse perinatal outcomes, respectively,

after controlling for other maternal risk factors.

A closer look at the results of the logistic regression analyses showed that, although in most instances the risk for adverse perinatal outcomes was lowest when the interpregnancy interval was between 18 and 23 months, the increase in the risk that is associated with interpregnancy intervals of 12 to 17 or 24 to 59 months was minimal. Only when the interval was excessively short (especially <6 months) or long (especially ≥ 120 months) did the risk increase appreciably.

Results

Table 7. Results of logistic regression analyses* of interpregnancy interval in relation to low birth weight, preterm birth, and small-for-gestational-age birth among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016

Interpregnancy Interval (months)	Preterm Birth		Low Birthweight		Small for Gestational Age	
	Adjusted OR	95% CI	Adjusted OR	95% CI	Adjusted OR	95% CI
White and Black women						
0-5	1.5	(1.4, 1.6)	1.5	(1.4, 1.6)	1.1	(1.0, 1.1)
6-11	1.1	(1.0, 1.2)	1.1	(1.0, 1.2)	1.0	(1.0, 1.1)
12-17	1.0	(1.0, 1.1)	1.0	(0.9, 1.1)	1.0	(0.9, 1.0)
18-23	1.0		1.0		1.0	
24-59	1.0	(1.0, 1.1)	1.1	(1.0, 1.1)	1.1	(1.1, 1.1)
60-119	1.2	(1.1, 1.2)	1.3	(1.2, 1.4)	1.2	(1.2, 1.3)
≥120	1.5	(1.4, 1.6)	1.7	(1.6, 1.8)	1.5	(1.4, 1.6)

* Analyses were controlled for maternal age at delivery, race, marital status, education, adequacy of prenatal care, outcome of the preceding birth (live birth or still birth), total number of previous pregnancies, tobacco use during pregnancy, and alcohol use during pregnancy.

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This slide shows further results of the logistic regression analyses of interpregnancy interval in relation to low birth weight, preterm birth, and small-for-gestational-age birth among multiparous white and black women in Michigan who delivered a singleton live infant between 2008 and 2016. These analyses were controlled for maternal age at delivery, race, marital status, education, adequacy of prenatal care, outcome of the preceding birth (live birth or still birth), total number of previous pregnancies, tobacco use during pregnancy, and alcohol use during pregnancy.

When controlling for all maternal risk factors simultaneously using logistic regression, the J-shaped relationship between interpregnancy interval and adverse perinatal outcomes persisted overall and among white and black women.

Women who had interpregnancy intervals of 18 to 23 months were at the lowest risk for delivering infants with the three adverse perinatal outcomes.

Among white and black women, an interpregnancy interval of <6 months was associated with an odds ratio of 1.5 (95% CI, 1.4%-1.6%) for preterm birth, 1.5 (95% CI, 1.4%- 1.6%) for low birth weight, and 1.1 (95% CI, 1.0%-1.1%) for small-for-gestational-age birth. An interval of ≥120 months was associated with an odds ratio of 1.5 (95% CI, 1.4%-1.6%), 1.7 (95% CI, 1.6%-1.8%), and 1.5 (95% CI, 1.4%-1.6%) for the three adverse perinatal outcomes,

respectively, after controlling for other maternal risk factors.

A closer look at the results of the logistic regression analyses showed that, although in most instances the risk for adverse perinatal outcomes was lowest when the interpregnancy interval was between 18 and 23 months, the increase in the risk that is associated with interpregnancy intervals of 12 to 17 or 24 to 59 months was minimal. Only when the interval was excessively short (especially <6 months) or long (especially ≥ 120 months) did the risk increase appreciably.

Results

- When controlling for all maternal risk factors simultaneously using logistic regression, the J-shaped relationship between interpregnancy interval and adverse perinatal outcomes persisted overall and among white and black women separately (Tables 5-7).
- Women who had interpregnancy intervals of 18 to 23 months were at the lowest risk for delivering infants with the three adverse perinatal outcomes.
- Among white women, an interpregnancy interval of <6 months was associated with an odds ratio of 1.5 (95% CI, 1.4%-1.6%) for preterm birth, 1.5 (95% CI, 1.4%-1.6%) for low birth weight, and 1.1 (95% CI, 1.0%-1.1%) for small-for-gestational-age birth. An interval of ≥ 120 months was associated with an odds ratio of 1.5 (95% CI, 1.4%-1.7%), 1.8 (95% CI, 1.6%-2.0%), and 1.5 (95% CI, 1.4%-1.6%) for the three adverse perinatal outcomes, respectively, after controlling for other maternal risk factors.
- Among black women, an interpregnancy interval of <6 months was associated with an odds ratio of 1.5 (95% CI, 1.3%-1.6%) for preterm birth, 1.4 (95% CI, 1.3%-1.6%) for low birth weight, and 1.1 (95% CI, 1.0%-1.2%) for small-for-gestational-age birth. An interval of ≥ 120 months was associated with an odds ratio of 1.4 (95% CI, 1.3%-1.6%), 1.5 (95% CI, 1.3%-1.7%), and 1.4 (95% CI, 1.3%-1.6%) for the three adverse perinatal outcomes, respectively, after controlling for other maternal risk factors.
- A closer look at the results of the stratified (Tables 2-4) and logistic regression (Tables 5-7) analyses showed that, although in most instances the risk for adverse perinatal outcomes was lowest when the interpregnancy interval was between 18 and 23 months, the increase in the risk that is associated with interpregnancy intervals of 12 to 17 or 24 to 59 months was minimal. Only when the interval was excessively short (especially <6 months) or long (especially ≥ 120 months) did the risk increase appreciably.

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This slide details additional summary results from the previous three slides.

When controlling for all maternal risk factors simultaneously using logistic regression, the J-shaped relationship between interpregnancy interval and adverse perinatal outcomes persisted overall and among white and black women separately (Tables 5-7).

Women who had interpregnancy intervals of 18 to 23 months were at the lowest risk for delivering infants with the three adverse perinatal outcomes.

Among white women, an interpregnancy interval of <6 months was associated with an odds ratio of 1.5 (95% CI, 1.4%-1.6%) for preterm birth, 1.5 (95% CI, 1.4%-1.6%) for low birth weight, and 1.1 (95% CI, 1.0%-1.1%) for small-for-gestational-age birth. An interval of ≥ 120 months was associated with an odds ratio of 1.5 (95% CI, 1.4%-1.7%), 1.8 (95% CI, 1.6%-2.0%), and 1.5 (95% CI, 1.4%-1.6%) for the three adverse perinatal outcomes, respectively, after controlling for other maternal risk factors.

Among black women, an interpregnancy interval of <6 months was associated with an odds ratio of 1.5 (95% CI, 1.3%-1.6%) for preterm birth, 1.4 (95% CI, 1.3%-1.6%) for low birth weight, and 1.1 (95% CI, 1.0%-1.2%) for small-for-gestational-age birth. An interval of ≥ 120 months was associated with an odds ratio of 1.4 (95% CI, 1.3%-1.6%), 1.5 (95% CI, 1.3%-

1.7%), and 1.4 (95% CI, 1.3%-1.6%) for the three adverse perinatal outcomes, respectively, after controlling for other maternal risk factors.

A closer look at the results of the stratified (Tables 2-4) and logistic regression (Tables 5-7) analyses showed that, although in most instances the risk for adverse perinatal outcomes was lowest when the interpregnancy interval was between 18 and 23 months, the increase in the risk that is associated with interpregnancy intervals of 12 to 17 or 24 to 59 months was minimal. Only when the interval was excessively short (especially <6 months) or long (especially ≥ 120 months) did the risk increase appreciably.

Conclusions

- Our study shows that an interpregnancy interval of 18 to 23 months was associated with the lowest risk for adverse perinatal outcomes for infants who were born to both white and black women; shorter and longer interpregnancy intervals were associated with increased risk.
- The J-shaped relationship between the interpregnancy interval and adverse perinatal outcomes persisted after controlling for other maternal risk factors, although only when the interpregnancy interval was excessively short or long did the risk increase appreciably.
- It seems that the association between interpregnancy interval and adverse perinatal outcomes is not due to confounding by other maternal risk factors.

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This slide details the conclusions of this study.

Our study shows that an interpregnancy interval of 18 to 23 months was associated with the lowest risk for adverse perinatal outcomes for infants who were born to both white and black women; shorter and longer interpregnancy intervals were associated with increased risk.

The J-shaped relationship between the interpregnancy interval and adverse perinatal outcomes persisted after controlling for other maternal risk factors, although only when the interpregnancy interval was excessively short or long did the risk increase appreciably.

It seems that the association between interpregnancy interval and adverse perinatal outcomes is not due to confounding by other maternal risk factors.

Conclusions

- Researchers have attributed the elevated risk of adverse perinatal outcomes that are associated with a short interpregnancy interval to postpartum nutritional depletion and stress (*Miller, 1991; Winkvist et al., 1992*).

- Maternal depletion hypothesis

- More than one year required to replete maternal resources essential for successful pregnancy

Winkvist et al 1992

- Adequate supply needed for balance between mother and fetus

- Biologic competition in setting of inadequacy
- Insufficient ability to support fetal growth and development

King, 2003

- Maternal stress

Lockwood, 1994

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This slide details additional conclusions of this study.

Researchers have attributed the elevated risk of adverse perinatal outcomes that are associated with a short interpregnancy interval to postpartum nutritional depletion and stress (*Miller, 1991; Winkvist et al., 1992*). The study of *Winkvist et al 1992* discussed maternal depletion hypothesis that more than one year required to replete maternal resources essential for successful pregnancy. The study of *King, 2003* mentioned adequate supply was needed for balance between mother and fetus, including biologic competition in setting of inadequacy and insufficient ability to support fetal growth and development. The study of *Lockwood, 1994* attributed the elevated risk of adverse perinatal outcomes that are associated with a short interpregnancy interval to maternal stress.

Conclusions

- Regarding the increased risk that is associated with a long interpregnancy interval, some hypotheses have been proposed (Klebanoff, 1999; Zhu *et al*, 2001).
 - The postpartum regression of the woman's physiologic condition to that of a primigravid woman;
 - Confounding by other unmeasured pathophysiologic factors that cause both delayed fertility and adverse perinatal outcomes and secondary infertility.

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This slide details further conclusions of this study.

Regarding the increased risk that is associated with a long interpregnancy interval, some hypotheses have been proposed (Klebanoff, 1999; Zhu *et al*, 2001). These include the postpartum regression of the woman's physiologic condition to that of a primigravid woman, confounding by other unmeasured pathophysiologic factors that cause both delayed fertility and adverse perinatal outcomes and secondary infertility.

Public Health Implications

- In the present study, an interpregnancy interval of 18 to 23 months was associated with the lowest risk for adverse perinatal outcomes among different racial groups.
- Health care providers (especially obstetricians, gynecologists, and family practice physicians) could use this information to advise postpartum women that delaying a subsequent pregnancy for approximately one and a half to two years can improve the likelihood of the delivery of a healthy baby *(Zhu et al, 2001)*.
- Programs that provide support services to women who are at high risk for adverse perinatal outcomes could include a component that addresses contraception *(Zhu et al, 2001)*.

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This slide details the public health implications of this study.

In the present study, an interpregnancy interval of 18 to 23 months was associated with the lowest risk for adverse perinatal outcomes among different racial groups.

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