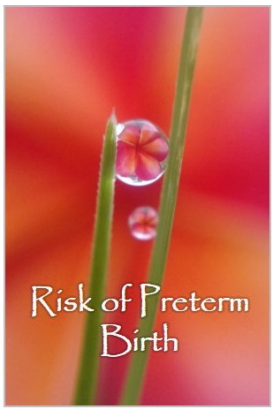

Prior Gestational Age and Subsequent Risk for Preterm Birth among Washington State Women

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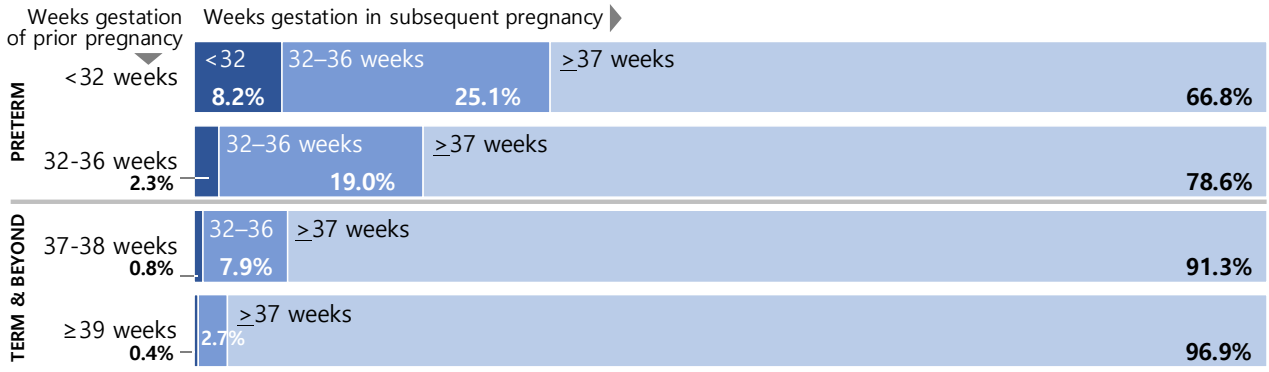
Prepared for Washington State Health Care Authority

PRETERM BIRTH (before 37 weeks gestation) is a leading cause of infant mortality and morbidity. Washington State has made significant progress reducing preterm births and currently has a relatively low preterm birth rate compared to other states at 8.4% (1). However, this rate is higher among the Medicaid population than among the non-Medicaid population (9.3% vs 7.6%). The Health Care Authority has therefore requested additional information regarding preterm birth to inform policies and programs for women on Medicaid coverage. Specifically, RDA was asked to explore rates of preterm birth as they relate to gestational age of prior deliveries and interpregnancy intervals (IPI).

Key Findings

1. **Women with shorter gestational age in the prior pregnancy were at an increased risk for a subsequent preterm birth.**
   - History of preterm birth was a very strong predictor of subsequent preterm birth for women, even after controlling for a comprehensive list of maternal risk factors.
   - Women whose previous deliveries were very preterm (<32 weeks of gestation) had the highest risk for subsequent very preterm birth (OR 23.05) and moderate to late preterm birth (32-36 weeks of gestation, OR 10.20).
   - Prior early term birth (37-38 weeks of gestation) was also associated with increased risk for subsequent very preterm birth (OR 1.99) and moderate to late preterm birth (OR 2.75).

Distribution of Length of Gestation of Subsequent Pregnancy by Length of Gestation of Prior Pregnancy among Washington State Women



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2. **An interpregnancy interval (IPI) of less than six months was associated with higher risk of subsequent very preterm births no matter the length of gestation of prior pregnancy, however, risk was highest among women with a prior preterm or early term birth.**
3. **Medicaid women were 60% and 24% more likely to have very preterm birth and moderate to late preterm birth, respectively, compared to non-Medicaid women.**
4. **Very preterm birth was also associated with:** younger age (<20 years old), black race, less than high school diploma, rural residence, receiving no prenatal care, gestational hypertension, pre-existing diabetes, Medicaid coverage, and receiving infertility treatment. *See Table 2, page 7.*

Background

Terms Used in this Study

Preterm Birth – Less than 37 weeks of gestation.
Very Preterm Birth – Less than 32 weeks of gestation.
Moderate to Late Preterm Birth – 32-36 weeks of gestation.
Early Term Birth – 37-38 weeks of gestation.
Interpregnancy Interval (IPI) – Time between a live birth and the beginning of the following pregnancy.

Preterm birth (delivery at less than 37 weeks' gestational age) is a leading cause of infant mortality and morbidity and affects 1 of every 10 infants born in the United States (2). Preterm birth is associated with approximately one-third of all infant deaths in the United States (3). Morbidity associated with preterm birth includes respiratory distress, cerebral palsy, vision or hearing problems, and developmental delay (4-5). Preterm birth occurs disproportionately in the Medicaid population and the costs of preterm birth to the public are substantial (6).

Reducing preterm birth, which remains a challenge, can be accomplished by identifying modifiable risk factors and implementing interventions that target such factors and populations at highest risk. A short interpregnancy intervals (time between a live birth and the beginning of the following pregnancy, IPI) is a known risk factor for subsequent preterm birth (7-8).

Approximately 30 percent of American women have a short IPI of less than 18 months (9). In addition, previous studies have shown that a history of previous preterm delivery confers an increased risk of preterm delivery in a subsequent pregnancy, with women having a very preterm delivery (<32 weeks of gestation) in the previous pregnancy having the highest risk (10-11). However, little attention is paid to the association of prior early term birth (37-38 weeks of gestation) with subsequent preterm birth. Since early term births account for one-fourth of all births in the United States (2), understanding the relationship between early term birth and subsequent risk for preterm birth has important clinical and public health implications.

Furthermore, few studies have examined the association of a short IPI with preterm birth when it is accompanied by gestational age of previous delivery. Whether short IPIs are associated with increased risk of preterm birth among women with a preceding preterm or early term birth to the same extent as among women with a preceding birth at ≥39 weeks of gestation is important when preconception counseling is provided.

In this report, we identified whether both prior preterm delivery and early term delivery increase the risk of preterm delivery in subsequent pregnancy. In addition, this report sought to evaluate whether the association between a short IPI and preterm birth is modified by gestational age of prior birth.

Methods

The study cohort was created using birth certificate data from Washington State Department of Health. Multiple births to the same mother over time were linked based on mother (first, middle, maiden, and last name), father (first, middle, and last name), date of maternal and child birth, residence address (street address, state, county, city, zip code), number of prior births, date of last birth, and mother's state/country of birth.

The study population included all women who delivered two consecutive singleton live births (≥20 weeks of gestation) in Washington State during 2010-2018. In the case of women who had more than two consecutive singleton live births during the study period (33,655 or 19.1%), only the first two births were included to avoid the effect of clustering. We excluded multiple births because of their known tendency to deliver preterm. Gravidity and parity reported on the birth certificate were used to exclude women who had miscarriages, elective abortion, or deliveries outside of Washington State between the two births.

Preterm birth refers to a delivery with a gestational age less than 37 weeks. We separated preterm births into two outcome groups based on gestational age: very preterm (<32 weeks) and moderate to late preterm (32-36 weeks) births. These two categories correspond to different levels of risk for infant mortality and morbidity (12-13). Length of gestation in the previous pregnancy was categorized into four subgroups: <32 weeks (very preterm), 32-36 weeks (moderate to late preterm), 37-38 weeks (early term), and ≥39 weeks (full term and beyond).

We define IPI as the period of time between the preceding live birth and subsequent conception. To calculate IPI, we subtracted the gestational age at birth of the subsequent pregnancy from the number of weeks between the two deliveries. We excluded women who had implausible IPIs (IPIs that were negative or shorter than 30 days). IPIs were categorized into six mutually exclusive levels: <6 months, 6-11 months, 12-17 months, 18-23 months, 24-36 months, and >36 months. The 18-23 months IPI group was used as the reference category (14).

A multinomial logistic regression model was constructed to examine the association of gestational age of prior birth with subsequent preterm birth (<32 weeks and 32-36 weeks) compared with gestational ages of ≥37 weeks in the subsequent pregnancy. We then evaluated the association between IPIs and preterm birth stratified by categories of gestational age of prior deliveries. Three categories correspond to different levels of risk for subsequent preterm birth: high risk (<37 weeks); medium risk (37-38 weeks); low risk (≥39 weeks). Because the number of prior deliveries less than 32 weeks was small, we combined them with those at 32-36 weeks' gestation in stratification analyses.

Other maternal risk factors included in the multinomial logistic regression model were: age at subsequent birth; race/ethnicity; marital status at subsequent birth; Women, Infants, and Children (WIC) benefit utilization during pregnancy; country of birth; education; rural/urban residence; pre-existing or gestational diabetes; pre-existing or gestational hypertension; smoking during pregnancy; prenatal care utilization; infertility treatment; cesarean delivery at prior birth; health insurance (Medicaid vs non-Medicaid); and year of delivery.

Women were determined to receive Medicaid benefits if their prenatal care and/or delivery costs were paid by Medicaid. The risk of preterm birth was expressed as adjusted odds ratios (OR) and their 95% confidence intervals (CI). P values <0.05 were considered statistically significant.

Results

We identified 125,575 singleton live births to women who had a previous live birth in Washington State during 2010-2018. Out of these births, 6,799 (5.4%) were preterm; 6,028 (4.8%) were moderate to late preterm (32-36 weeks) and 771 (0.6%) were very preterm (<32 weeks).

Overall, 5.9% of births occurred to women with a preceding preterm birth while 20.7% occurred to women with a prior early term birth (37-38 weeks) (Table 1). The rate of preterm birth in the subsequent pregnancy increased as the length of prior pregnancy decreased. Among women whose prior pregnancy ended in very preterm birth, 25.1% had a moderate to late preterm delivery in their subsequent pregnancy while 8.2% of them had a very preterm delivery. Among women who had a prior early term delivery, 7.9% had a subsequent moderate to late preterm delivery and 0.8% had a subsequent very preterm delivery (Table 1 and Figure 1).

More than one-fifth of births were conceived within a year of prior birth, with 5.6% having an IPI of <6 months. Six percent of women smoked during pregnancy and nearly half of women received Medicaid coverage during pregnancy and/or at birth. Medicaid women had a higher rate of preterm birth than non-Medicaid women (6.7% vs 4.2%). Native American women had the highest proportion of preterm birth, with 1.2% of births being very preterm and 11.2% of births being moderate to late preterm, while non-Hispanic White women had the lowest proportion of preterm birth (4.7%). Women less than 20 years old had a higher proportion of preterm birth, with 1.6% of births being very preterm and 7.8% being moderate to late preterm birth, compared with women aged 20 or older (Table 1).

In multivariate analysis, length of gestation in the prior pregnancy was found to be negatively associated with preterm birth in the subsequent pregnancy. Women whose prior delivery was very preterm (<32 weeks) were at the highest subsequent risk for very preterm birth (OR 23.05, 95% CI 17.52-30.32) and moderate to late preterm birth (OR 10.20, 95% CI 8.68-11.98), compared to women with prior pregnancy gestation ≥39 weeks (Table 2). An increased risk for preterm birth was also observed among women whose prior birth was early term (37-38 weeks). Compared to women whose prior delivery was ≥39 weeks of gestation, women with a previous early term delivery had an increased risk for very preterm birth (OR 1.99, 95% CI 1.67-2.38) and moderate to late preterm birth in the subsequent pregnancy (OR 2.75, 95% CI 2.58-2.92).

The association between IPI and preterm birth was time-dependent, shorter or longer IPIs had elevated risk of a subsequent preterm birth. The shortest IPI (<6 months) had the strongest association with very preterm birth (OR 2.14, 95% CI 1.58-2.90) and moderate to late preterm birth (OR 1.64, 95% CI 1.46-1.85) compared with IPIs of 18-23 months. IPIs of 6-11 months were also associated with very preterm birth (OR 1.35, 95% CI 1.03-1.77) and moderate to late preterm birth (OR 1.19, 95% CI 1.08-1.31). Significant association was observed between IPIs longer than 36 months and very preterm birth (OR 1.80, 95% CI 1.38-2.35) and moderate to late preterm birth (OR 1.36, 95% CI 1.23-1.49).

A number of other maternal risk factors were associated with preterm birth. Black women were more than twice as likely to deliver the second child before 32 weeks of gestation (OR 2.13, 95% CI 1.58-2.88) compared with white women. Asian women were more likely to have both very preterm birth (OR 1.90, 95% CI 1.42-2.54) and moderate to late preterm birth (OR 1.33, 95% CI 1.19-1.49) than white women. Women who received no prenatal care during pregnancy were over eight times more likely to have a very preterm birth (OR 8.50, 95% CI 5.83-12.39) and nearly five times more likely to have moderate to late preterm birth in the subsequent pregnancy (OR 4.97, 95% CI 4.10-6.03), compared to women who initiated prenatal care in the first trimester. Women with pre-existing diabetes, gestational diabetes, pre-existing hypertension, or gestational hypertension were also at increased risk for preterm birth. Smoking increased the risk of moderate to late preterm birth (OR 1.25, 95% CI 1.13-1.38) but not very preterm birth (OR 1.26, 95% CI 0.97-1.62). Medicaid women were 60% and 24% more likely to

have very preterm birth and moderate to late preterm birth, respectively, compared to non-Medicaid women.

To identify whether the associations between a short IPI and preterm birth vary by history of preterm delivery, we stratified the cohort by gestational age of prior deliveries. An IPI <6 months was associated with a higher risk for very preterm delivery than moderate to later preterm delivery.

While the shortest IPI (<6 months) was associated with higher risk of subsequent very preterm births for women of all gestational ages, the increased risk of very preterm delivery was more pronounced for women with a preceding preterm birth (OR 2.47, 95% CI 1.43-4.25) and early term birth (OR 2.70, 95% CI 1.45-5.02). The association between IPIs of 6-11 months and very preterm birth was only significant for women with a previous preterm birth (OR 1.80, 95% CI 1.10-2.96) (Table 3).

TABLE 1.

Gestational Age Distribution at Subsequent Births by Maternal Risk Factors, 2010-2018

	Gestational Age at Subsequent Birth							
	<32 weeks		32-36 weeks		≥37 weeks		All	
	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT
TOTALS	**771**	**0.6%**	**6,028**	**4.8%**	**118,776**	**94.6%**	**125,575**	
Gestational age at prior birth								
<32 weeks	78	8.2%	239	25.1%	637	66.8%	954	0.8%
32-36 weeks	150	2.3%	1,222	19.0%	5,046	78.6%	6,418	5.1%
37-38 weeks	206	0.8%	2,058	7.9%	23,763	91.3%	26,027	20.7%
≥39 weeks	337	0.4%	2,509	2.7%	89,330	96.9%	92,176	73.4%
Interpregnancy interval								
<6 months	93	1.3%	584	8.4%	6,290	90.3%	6,967	5.6%
6-11 months	132	0.7%	1,016	5.0%	19,081	94.3%	20,229	16.1%
12-17 months	131	0.5%	1,098	4.0%	26,154	95.5%	27,383	21.8%
18-23 months	92	0.4%	869	3.9%	21,148	95.7%	22,109	17.6%
24-36 months	142	0.5%	1,197	4.5%	25,389	95.0%	26,728	21.3%
>36 months	181	0.8%	1,264	5.7%	20,714	93.5%	22,159	17.7%
Maternal age at subsequent birth								
<20	37	1.6%	179	7.8%	2,093	90.7%	2,309	1.8%
20-34	597	0.6%	4,706	4.7%	95,667	94.8%	100,970	80.4%
≥35	137	0.6%	1,143	5.1%	21,016	94.3%	22,296	17.8%
Race/ethnicity								
Non-Hispanic white	371	0.5%	3,326	4.2%	74,686	95.3%	78,383	62.4%
Hispanic	180	0.8%	1,267	5.5%	21,755	93.8%	23,202	18.5%
Black	60	1.3%	227	5.0%	4,274	93.7%	4,561	3.6%
Native American	23	1.2%	208	11.2%	1,631	87.6%	1,862	1.5%
Asian	74	0.8%	546	5.5%	9,245	93.7%	9,865	7.9%
Pacific Islander	11	0.7%	121	7.4%	1,515	92.0%	1,647	1.3%
Other	8	1.2%	29	4.3%	645	94.6%	682	0.5%
More than 1 race	35	0.7%	271	5.6%	4,549	93.7%	4,855	3.9%
Unknown	9	1.7%	33	6.4%	476	91.9%	518	0.4%
WIC benefit								
Yes	310	0.7%	2,494	6.0%	38,931	93.3%	41,735	33.2%
No	427	0.6%	3,222	4.2%	73,731	95.3%	77,380	61.6%
Unknown	34	0.5%	312	4.8%	6,114	94.6%	6,460	5.1%
Mother born in the US								
Yes	558	0.6%	4,478	4.8%	88,719	94.6%	93,755	74.7%
No	201	0.7%	1,503	4.8%	29,445	94.5%	31,149	24.8%
Unknown	12	1.8%	47	7.0%	612	91.2%	671	0.5%

	Gestational Age at Subsequent Birth							
	<32 weeks		32-36 weeks		≥37 weeks		All	
	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT
Mother education level								
Less than high school diploma	160	1.1%	992	6.7%	13,763	92.3%	14,915	11.9%
High school diploma	186	0.7%	1,505	5.5%	25,859	93.9%	27,550	21.9%
Some college	245	0.6%	1,923	4.8%	38,068	94.6%	40,236	32.0%
Bachelor's degree or higher	161	0.4%	1,530	3.7%	39,905	95.9%	41,596	33.1%
Unknown	19	1.5%	78	6.1%	1,181	92.4%	1,278	1.0%
Marital status								
Yes	464	0.5%	3,938	4.2%	88,369	95.3%	92,771	73.9%
No	299	0.9%	2,076	6.4%	30,201	92.7%	32,576	25.9%
Unknown	8	3.5%	14	6.1%	206	90.4%	228	0.2%
Residence								
Urban - high density	508	0.6%	4,020	4.6%	82,791	94.8%	87,319	69.5%
Urban - medium & low density	159	0.7%	1,201	5.4%	20,939	93.9%	22,299	17.8%
Large town	68	0.6%	607	5.0%	11,512	94.5%	12,187	9.7%
Rural	36	1.0%	200	5.3%	3,534	93.7%	3,770	3.0%
Pre-existing diabetes								
Yes	34	2.5%	227	16.8%	1,091	80.7%	1,352	1.1%
No	737	0.6%	5,801	4.7%	117,685	94.7%	124,223	98.9%
Gestational diabetes								
Yes	71	0.7%	736	7.7%	8,792	91.6%	9,599	7.6%
No	700	0.6%	5,292	4.6%	109,984	94.8%	115,976	92.4%
Pre-existing hypertension								
Yes	45	1.8%	312	12.2%	2,202	86.1%	2,559	2.0%
No	726	0.6%	5,716	4.7%	116,574	94.8%	123,016	98.0%
Gestational hypertension								
Yes	93	1.7%	732	13.4%	4,647	84.9%	5,472	4.4%
No	678	0.6%	5,296	4.4%	114,129	95.0%	120,103	95.6%
Cigarette smoking								
Yes	86	1.1%	603	8.0%	6,833	90.8%	7,522	6.0%
No	675	0.6%	5,373	4.6%	111,111	94.8%	117,159	93.3%
Unknown	10	1.1%	52	5.8%	832	93.1%	894	0.7%
Prenatal care initiation								
1st trimester	408	0.5%	3,785	4.1%	87,372	95.4%	91,565	72.9%
2nd trimester	132	0.6%	1,029	4.5%	21,687	94.9%	22,848	18.2%
3rd trimester	16	0.3%	216	4.3%	4,777	95.4%	5,009	4.0%
No prenatal care	37	4.6%	166	20.6%	603	74.8%	806	0.6%
Unknown	178	3.3%	832	15.6%	4,337	81.1%	5,347	4.3%
Infertility treatment								
Yes	15	1.8%	54	6.5%	763	91.7%	832	0.7%
No	756	0.6%	5,974	4.8%	118,013	94.6%	124,743	99.3%
Medicaid								
Yes	510	0.8%	3,602	5.9%	57,155	93.3%	61,267	48.8%
No	261	0.4%	2,426	3.8%	61,621	95.8%	64,308	51.2%
Cesarean delivery, prior birth								
Yes	255	0.9%	1,837	6.3%	26,963	92.8%	29,055	23.1%
No	516	0.5%	4,191	4.3%	91,813	95.1%	96,520	76.9%
Year of subsequent birth								
2010-2014	319	0.6%	2,462	4.9%	47,926	94.5%	50,707	40.4%
2015-2018	452	0.6%	3,566	4.8%	70,850	94.6%	74,868	59.6%

FIGURE 1.

Distribution of Length of Gestation of Subsequent Pregnancy by Length of Gestation of Prior Pregnancy among Washington State Women

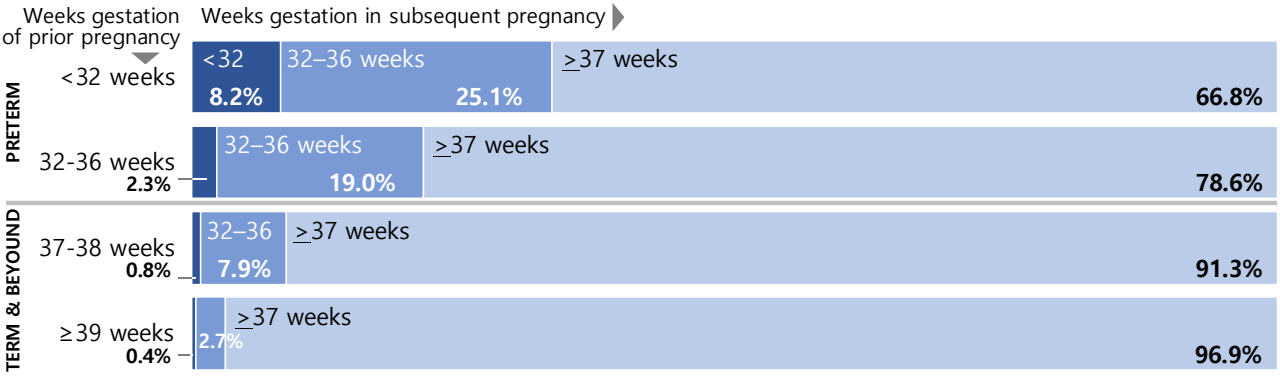

TABLE 2.

Association between Maternal Risk Factors with Preterm Birth (Gestational Age <32 Weeks or 32-36 Weeks) Compared with Gestational Age of ≥37 Weeks

	Gestational Age			
	<32 weeks		32-36 weeks	
Variable (comparison category)	ODDS RATIO	95% CONFIDENCE INTERVAL	ODDS RATIO	95% CONFIDENCE INTERVAL
Gestational age at prior birth (≥39 weeks)				
<32 weeks	23.05**	(17.52-30.32)	10.20**	(8.68-11.98)
32-36 weeks	6.15**	(5.03-7.51)	7.06**	(6.54-7.63)
37-38 weeks	1.99**	(1.67-2.38)	2.75**	(2.58-2.92)
Interpregnancy interval (18-23 months)				
<6 months	2.14**	(1.58-2.90)	1.64**	(1.46-1.85)
6-11 months	1.35*	(1.03-1.77)	1.19**	(1.08-1.31)
12-17 months	1.16	(0.89-1.52)	1.03	(0.94-1.13)
24-36 months	1.26	(0.97-1.65)	1.14**	(1.04-1.25)
>36 months	1.80**	(1.38-2.35)	1.36**	(1.23-1.49)
Maternal age at subsequent birth (20-34 years old)				
<20	1.63*	(1.12-2.36)	1.23*	(1.03-1.46)
≥35	1.08	(0.88-1.32)	1.14**	(1.06-1.23)
Race/ethnicity (Non-Hispanic white)				
Hispanic	1.30*	(1.04-1.62)	1.05	(0.96-1.14)
Black	2.13**	(1.58-2.88)	0.96	(0.82-1.11)
Native American	1.27	(0.81-1.99)	1.66**	(1.41-1.96)
Asian	1.90**	(1.42-2.54)	1.33**	(1.19-1.49)
Pacific Islander	0.96	(0.51-1.78)	1.22	(1.00-1.50)
Other	2.49*	(1.20-5.18)	0.93	(0.63-1.38)
More than one race	1.16	(0.81-1.66)	1.11	(0.97-1.27)
Unknown	1.77	(0.81-3.86)	1.12	(0.76-1.66)
WIC benefit (No)				
Yes	0.76**	(0.63-0.92)	1.08*	(1.00-1.16)
Unknown	0.60**	(0.41-0.87)	0.98	(0.86-1.11)
Mother born in the US (No)				
Yes	1.19	(0.97-1.47)	1.08*	(1.00-1.17)
Unknown	1.52	(0.77-2.99)	1.12	(0.80-1.55)

	Gestational Age			
	<32 weeks		32-36 weeks	
Variable (comparison category)	ODDS RATIO	95% CONFIDENCE INTERVAL	ODDS RATIO	95% CONFIDENCE INTERVAL
Mother education level (High school diploma)				
Less than high school diploma	1.35**	(1.08-1.70)	1.10*	(1.00-1.20)
Some college	1.07	(0.87-1.31)	0.98	(0.91-1.06)
Bachelor's degree or higher	0.89	(0.69-1.15)	0.94	(0.85-1.03)
Unknown	1.54	(0.88-2.71)	1.03	(0.79-1.34)
Marital status (Yes)				
No	1.03	(0.86-1.24)	1.04	(0.97-1.11)
Unknown	2.55*	(1.11-5.85)	0.91	(0.51-1.63)
Residence (Urban - high density)				
Urban - medium & low density	1.07	(0.88-1.30)	1.02	(0.95-1.10)
Large town	0.96	(0.74-1.26)	1.02	(0.93-1.12)
Rural	1.67**	(1.17-2.38)	1.05	(0.90-1.23)
Pre-existing diabetes	2.73**	(1.88-3.96)	2.28**	(1.94-2.68)
Gestational diabetes	1.03	(0.80-1.32)	1.37**	(1.26-1.50)
Pre-existing hypertension	1.77**	(1.27-2.45)	1.64**	(1.43-1.87)
Gestational hypertension	2.40**	(1.91-3.02)	2.36**	(2.15-2.58)
Cigarette smoking during pregnancy (No)				
Yes	1.26	(0.97-1.62)	1.25**	(1.13-1.38)
Unknown	1.26	(0.65-2.46)	0.92	(0.68-1.25)
Prenatal care initiation (1st trimester)				
2nd trimester	1.09	(0.89-1.33)	0.98	(0.91-1.05)
3rd trimester	0.53*	(0.32-0.88)	0.85*	(0.73-0.98)
No prenatal care	8.50**	(5.83-12.39)	4.97**	(4.10-6.03)
Unknown	7.98**	(6.63-9.61)	4.06**	(3.73-4.43)
Infertility treatment	3.65**	(2.11-6.31)	1.34*	(1.00-1.80)
Medicaid	1.60**	(1.29-1.99)	1.24**	(1.14-1.34)
Cesarean delivery, prior birth	1.40**	(1.19-1.64)	1.32**	(1.24-1.40)
Year of subsequent birth (2010-2014)				
2015-2018	0.90	(0.77-1.06)	0.96	(0.90-1.02)

**p<0.01; *p<0.05.

TABLE 3.

Risk of Preterm Birth in the Subsequent Pregnancy According to Categories of Interpregnancy Interval, Stratified by Gestational Age at Prior Birth

	Gestational Age at Subsequent Birth: <32 Weeks					
	Gestational age at prior birth					
	≤36 weeks		37-38 weeks		≥39 weeks	
Interpregnancy Interval	ODDS RATIO	95% CONFIDENCE INTERVAL	ODDS RATIO	95% CONFIDENCE INTERVAL	ODDS RATIO	95% CONFIDENCE INTERVAL
<6 months	**2.47****	**(1.43-4.25)**	**2.70****	**(1.45-5.02)**	**1.85****	**(1.16-2.94)**
6-11 months	**1.80***	**(1.10-2.96)**	1.58	(0.90-2.81)	1.08	(0.72-1.62)
12-17 months	1.06	(0.62-1.80)	1.66	(0.96-2.87)	1.00	(0.68-1.48)
18-23 months	1		1		1	
24-36 months	0.98	(0.57-1.67)	1.70	(0.99-2.93)	1.23	(0.84-1.79)
>36 months	**1.84***	**(1.11-3.04)**	**2.59****	**(1.52-4.44)**	**1.47***	**(1.00-2.17)**

Interpregnancy Interval	Gestational Age at Subsequent Birth: 32-36 Weeks					
	Gestational age at prior birth					
	≤36 weeks		37-38 weeks		≥39 weeks	
	ODDS RATIO	95% CONFIDENCE INTERVAL	ODDS RATIO	95% CONFIDENCE INTERVAL	ODDS RATIO	95% CONFIDENCE INTERVAL
<6 months	**1.35***	**(1.05-1.74)**	**1.74****	**(1.43-2.12)**	**1.79****	**(1.50-2.14)**
6-11 months	1.17	(0.95-1.44)	1.18	(1.00-1.39)	**1.23****	**(1.06-1.42)**
12-17 months	1.01	(0.82-1.23)	1.05	(0.89-1.23)	1.03	(0.90-1.19)
18-23 months	1		1		1	
24-36 months	1.04	(0.85-1.28)	1.15	(0.98-1.35)	**1.17***	**(1.02-1.35)**
>36 months	**1.29***	**(1.04-1.59)**	**1.32****	**(1.12-1.55)**	**1.40****	**(1.21-1.61)**

**p<0.01; *p<0.05.

Discussion

Our report confirms that a history of preterm birth is a strong predictor of subsequent preterm birth with women who had a very preterm delivery in the prior pregnancy having the highest risk (9-10). Consistent with Yang et al (10), we also found that women with a prior early term birth are at higher risk for subsequent preterm birth compared to women with a prior birth of ≥39 weeks of gestation. Although prior early term birth is a less strong predictor of subsequent preterm birth than prior preterm birth, about one-fourth of births are early term in the United States each year, making history of early term birth an important risk factor for subsequent preterm birth.

Early term delivery was associated with increased neonatal and infant morbidity and mortality compared with deliveries at 39 weeks of gestation or more (15-17). The identification of early term birth as a risk factor for preterm delivery in the subsequent pregnancy further highlights the importance of delaying elective (i.e., not medically indicated) deliveries until 39 weeks of gestation or beyond (18).

The fact that the risk of preterm birth in the subsequent pregnancy increased as the length of prior pregnancy decreased even after controlling for various maternal risk factors suggested that gestational weeks of prior pregnancy is a good proxy for specific exposures that can affect both births. Although many risk factors for preterm birth have been identified, the underlying mechanisms remain largely unknown. Further research is needed to disentangle these complexities in preterm birth reoccurrence.

Our results confirm that IPIs shorter than 12 months were an independent risk factor for very preterm birth and moderate to late preterm birth with a magnitude similar to those previously reported (19-20). In addition, the association was stronger among women with IPI <6months than for women with IPI 6-11 months. Previous studies have suggested a J-shape relationship between IPI and preterm birth with both short and long IPIs being associated with preterm birth. We observed a similar relationship with long IPIs. However the etiology underlying this association is not well understood. Current clinical and public health recommendations advise women to avoid IPIs shorter than 18 months (21-22). However, along with some other studies, our findings suggest that the optimal IPI might be in the range of 12-24 months (23-24).

Although a short IPI (<6 months) was associated with an elevated risk of very preterm birth no matter the length of gestation of prior pregnancy, the risk was highest among women with a prior preterm or early term birth. Avoidance of IPIs shorter than 6 month, which can be achieved through postpartum provision of contraception, is critically important for women with a history of preterm birth or early term birth.

Our results identifying the association between a number of risk factors and very preterm birth are consistent with previous studies including younger age (<20 years old), black race, less than high school diploma, rural residence, receiving no prenatal care during pregnancy, pre-existing and gestational hypertension, pre-existing diabetes, Medicaid coverage, and infertility treatment. Moderate to late preterm birth and very preterm birth share most of the common risk factors.

Several limitations should be considered. This report relied on data from birth certificates for the analyses. Data were not available for other important risk factors such as substance use disorder (25), urogenital infections (26), depression (27), and other maternal chronic conditions (renal insufficiency, cardiac disease, and restrictive lung disease). Our findings need to be further investigated in preterm birth subgroups (spontaneous or medically indicated) as more clinical information becomes available in the future.

In summary, both preterm birth and early term birth are associated with subsequent preterm birth. More clinical attention to prior early term birth as well as prior preterm birth may be warranted in order to reduce the occurrence of subsequent preterm births. Avoiding IPIs of less than 6 months is especially important for women who had a previous preterm or early term birth to reduce the risk of very preterm birth in the subsequent pregnancy.

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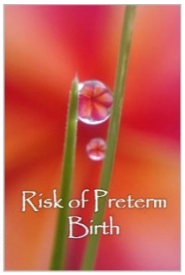

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