INTERPREGNANCY INTERVAL AND NEONATAL OUTCOMES

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Abstract

•**Objective**: Determine the relationship between interpregnancy interval (IPI) and neonatal outcomes, including preterm birth (gestational age <37 weeks), low birth weight (<2500g), and small for gestational age (birth weight < 10th percentile for gestational age), respiratory morbidities, and neurological morbidities.

•**Study Design**: Retrospective cohort study comparing neonatal outcomes across 6 categories of IPI using data from Arizona birth certificates and the Newborn Intensive Care Program. Comparisons between groups were evaluated by calculating odds ratios and 95% confidence intervals. Logistic regression will be conducted to adjust for sociodemographic factors.

•**Results**: Analysis included 207,439 cases. Table 1 shows odds ratios and 95% confidence intervals for neonatal outcomes by IPI.

•**Conclusion**: Significant differences in neonatal outcomes (preterm birth, low birth weight, and small for gestational age) were observed between IPI categories. Interpregnancy intervals < 6 months and ≥ 60 months appear to be associated with increased risk of poor neonatal outcomes.

Introduction

- Interpregnancy interval (IPI) is the time period between a woman giving birth and the conception of a subsequent pregnancy. The length of this time period can have important implications for maternal and infant morbidity and mortality.
  - IPI < 12-18 months and > 59 months is associated with increased risk of preterm birth, low birth weight, and SGA
  - Very short IPI (< 6 months) is associated with increased risk of preterm birth and neonatal death

Previous Studies of IPI

- IPI < 6 months associated with increased risk of neonatal death
  - (Smith, Pell, and Dobbie, 2003)
- IPI of 12-23 months had lowest risk of poor birth outcomes
  - (Conde-Agudelo, Belizan, Norton, and Rosas-Bermudas, 2005)
- IPI < 18 months or > 23 associated with increased risk of poor birth outcomes
  - (Zhu 2005)
- IPI < 18 months and > 59 months associated with preterm birth, low birth weight, and SGA
  - (Conde-Agudelo, Rosas – Bermudez, and Kafury – Goeta, 2006)
- IPI < 6 months associated with increased risk of preterm birth
  - (Rodrigues & Barros 2007)

Objective: Determine the relationship between interpregnancy interval and the following neonatal outcomes and morbidities:

- Preterm birth (gestational age < 37 weeks)
- Low birth weight (<2500g)
- Small for gestational age (birth weight < 10th percentile)
- Respiratory morbidities
- Neurologic morbidities
- Other morbidities

Study Design

Retrospective cohort study comparing neonatal outcomes across 6 categories of IPI.

The dataset used for this study contains data from the Newborn Intensive Care Program (NICP) linked with Arizona birth certificate data from 1994 to 1998.

- Inclusion criteria:
  - Infants with Arizona birth certificate data available
  - Infants in NICP program
  - IPI able to be calculated from available data
- Exclusion criteria:
  - Prima para
  - Twin births
  - IPI unknown

Study Population

207,439 cases involved in the analysis

- Age range 13-54 yrs
- Race / ethnicity:
  - Caucasian – 49.5%
  - Hispanic (U.S. born) – 15.2%
  - Hispanic (foreign born) – 20.0%
  - African American – 3.3%
  - Native American – 8.2%
  - Asian – 3.7%
- IPI categories:
  - < 6 months - 6.0%
  - 6-11 months - 12.7%
  - 12-17 months - 13.4%
  - 18-23 months - 11.5%
  - 24-59 months - 37.7%
  - ≥ 60 months - 18.6%

Methods

Of 19, 890 infants enrolled in the NICP, 98% were matched to Arizona birth certificates. NICP data for an infant and data from the infant's birth certificate were combined into a single case.

IPI was calculated by determining the time interval between births and subtracting the gestational age of the case neonate.

IPI categorization into groups was consistent with previous research. Comparisons between IPI groups were evaluated by calculating odds ratios and 95% confidence intervals.

Logistic regression was conducted to adjust for the effects of sociodemographic factors, preterm birth, and low birth weight on neonatal morbidities.

Table 1. Demographic characteristics by length of IPI.

	< 6 mos		6 - 11 mos		12 - 17 mos		18 - 23 mos		24 - 59 mos		≥ 60 mos	
	N	%	N	%	N	%	N	%	N	%	N	%
Race / Ethnicity												
Asian	455	3.75	943	3.68	1011	3.72	846	3.84	2806	3.69	1453	3.88
African American	391	4.87	964	3.76	853	3.13	668	2.87	2298	3.02	1343	3.58
White non-Hispanic	4623	39.73	12574	49.04	14437	53.05	12763	54.86	37480	49.28	17656	47.09
Hispanic US-born	2449	20.17	4133	16.12	3939	14.48	3266	14.04	11331	14.90	5605	14.94
Hispanic Mexico-born	2502	20.61	4762	18.57	4619	16.97	3880	16.68	16468	21.65	8342	22.25
Native American	1319	10.87	2262	8.82	2353	8.65	1853	7.97	5675	7.46	3096	8.26
Age (years)												
< 18	459	3.77	600	2.33	321	1.17	166	0.71	101	0.13	1	0.00
18 – 24	6110	50.14	10711	41.80	10393	37.39	7960	34.05	20996	27.50	1977	5.25
25-29	3078	25.26	7219	28.03	7628	28.85	7029	30.11	25745	33.72	10832	28.46
30 – 34	1822	14.95	4935	19.17	6034	22.09	5813	24.94	19515	25.56	13412	35.62
35+	718	5.88	2285	8.87	2934	10.74	2580	11.06	9864	13.08	11572	30.73
Education (years)												
<12	5108	42.40	8378	32.54	7719	28.25	6045	25.89	20955	27.45	9774	25.96
12	3772	30.96	7917	30.75	8106	29.68	6999	29.98	25145	32.94	13716	36.43
>12	3247	26.65	9455	36.72	11490	42.07	10304	44.13	30242	39.61	14165	37.62
Marital Status												
Unmarried	5817	46.11	8996	34.95	8194	29.87	6471	27.72	22417	29.37	12603	33.47
Married	6984	53.89	16747	65.05	19212	70.33	16873	72.28	53903	70.63	25046	66.53
Insurance												
Medicaid	7114	61.19	12441	50.31	11554	44.91	9295	43.31	32084	43.45	15018	41.33
Private	3616	31.10	10547	42.65	12906	49.17	11729	52.12	36798	49.84	18575	51.12
Self/Unknown	896	7.71	1739	7.03	1789	6.81	1479	6.57	4956	6.71	2746	7.56
Parity												
1	5544	45.52	12849	49.93	14129	51.73	12324	52.80	39523	51.52	17570	46.15
2+	6636	54.48	12887	50.07	13185	48.27	11016	47.20	37003	48.48	20267	53.85
Kotelchuk Index*												
Inadequate	4433	37.24	6962	27.20	5728	21.24	4167	18.13	12693	16.80	6110	16.39
Intermediate	1382	11.61	3363	13.02	3637	13.48	3064	13.27	10180	13.47	4918	13.19
Adequate	3549	29.81	9330	36.77	10986	40.73	9861	42.70	32351	42.82	15460	41.47
Adequate Plus	2541	21.34	5838	23.01	6622	24.55	5980	25.90	20526	26.96	10796	28.96
Chronic Hypertension												
No	12151	99.72	25679	99.72	27238	99.70	23273	99.68	76005	99.56	37372	99.25
Yes	34	0.28	71	0.28	82	0.30	75	0.32	336	0.44	283	0.75
Smoker												
No	10613	86.91	22812	89.14	24620	90.63	21029	90.55	68031	89.63	32075	85.70
Yes	1593	13.09	2779	10.86	2546	9.37	2195	9.45	7869	10.37	5353	14.30
Diabetes												
No	11836	97.96	25232	97.39	26729	97.84	22805	97.87	74127	97.10	35966	95.51
Yes	249	2.04	518	2.01	591	2.16	543	2.33	2214	2.90	1689	4.49

Abbreviations: IPI, interpregnancy interval
* The Kotelchuk Index, or Adequacy of Prenatal Care Utilization Index, is a classification based on when prenatal care was initiated and the number of prenatal visits (15)

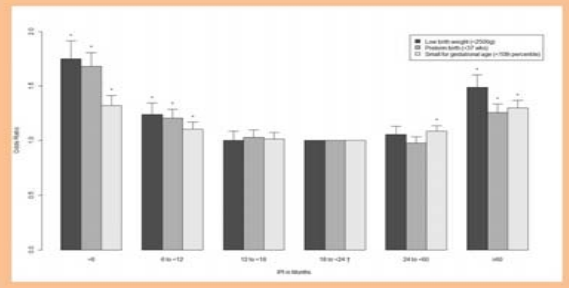

Figure 1. Odds ratios and 95% confidence intervals for preterm birth, low birth weight, and small for gestational age (SGA) by IPI category.

Footnote: * p< 0.05 from the reference group; † reference group

Table 2. Neonatal morbidities by IPI (unadjusted.)

	< 6 months			6-11 months			12-17 months			18-23 months †			24-59 months			≥ 60 months		
Neonatal mortbidities	OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI		OR	95% CI	
Low birth weight	1.750	1.600 - 1.915*		1.239	1.143 - 1.343*		1.000	.921 - 1.087		1.000			1.056	.966 - 1.132		1.490	1.385 - 1.602*	
Preterm birth	1.681	1.563 - 1.808*		1.207	1.132 - 1.288*		1.013	0.956 - 1.072		1.000			0.978	.925 - 1.034		1.257	1.184 - 1.334*	
Small for Gestational Age	1.321	1.235 - 1.414*		1.104	1.042 - 1.169*		1.013	0.956 - 1.072		1.000			1.064	1.033 - 1.137*		1.298	1.233 - 1.367*	
Interventricular hemorrhage	1.917	.831 - 4.423		1.072	.460 - 2.392		0.855	.370 - 1.971		1.000			1.148	.739 - 2.721		2.143	1.095 - 4.193*	
Apnea bradycardia	1.576	1.102 - 2.252*		1.341	.963 - 1.830		0.854	.609 - 1.199		1.000			1.087	.828 - 1.426		1.399	1.049 - 1.866*	
Bronchopulmonary dysplasia	3.152	1.621 - 6.127*		1.749	.917 - 3.337		0.977	.477 - 2.001		1.000			1.049	.578 - 1.902		1.506	.808 - 2.807	
Periventricular leukomalacia	4.473	1.156 - 17.300*		2.116	.547 - 8.184		1.140	.255 - 5.092		1.000			1.223	.345 - 4.336		1.860	.504 - 6.872	
Respiratory Distress Syndrome	1.674	1.423 - 1.969*		1.147	.969 - 1.330		0.993	.855 - 1.155		1.000			1.004	.885 - 1.138		1.312	1.147 - 1.500*	
Suspected Sepsis	1.480	1.295 - 1.690*		1.091	.970 - 1.228		0.953	.845 - 1.074		1.000			1.026	.929 - 1.133		1.251	1.124 - 1.392*	
Transient Tachypnea of the Newborn	1.351	0.992 - 1.840		1.046	.797 - 1.371		0.775	.582 - 1.034		1.000			0.983	.783 - 1.234		1.229	.963 - 1.567	

Abbreviations: CI, confidence intervals; IPI, interpregnancy interval; OR, odds ratio
* p < .05
† Reference Group

Results

- Women with IPI of < 6 months were more likely to be unmarried, have < 12 years of education, have AHCCCS as their payer, and have inadequate prenatal care. Women with IPI of ≥ 60 months were more likely to have chronic hypertension and diabetes. Smoking was more common among women with IPI of < 6 months or ≥ 60 months. (Table 1)
- IPI of < 6 months, 6-11 months, and ≥ 60 were associated with increased risk of low birth weight, preterm birth, and SGA. (Fig 1)
- Neonatal morbidities and IPI: (Table 2)
  - IPI of < 6 months was associated with periventricular leukomalacia and bronchopulmonary dysplasia
  - IPI of ≥ 60 months was associated with intraventricular hemorrhage.
  - IPI of both < 6 months and ≥ 60 months were associated with increased risk of apnea bradycardia, respiratory distress syndrome, and suspected sepsis.
  - These relationships did not persist after adjusting for demographics, birth weight, and gestational age.

Discussion

- Consistent with prior studies, IPI of < 12 months or ≥ 60 months showed increased risk of low birth weight, preterm birth, and small for gestational age. These relationships persisted when adjusted for other predictors.
- IPI intervals < 6 months or ≥ 60 months carried the greatest risk of neonatal morbidities, including periventricular leukomalacia, bronchopulmonary dysplasia, and intraventricular hemorrhage. None of the relationships between IPI and specific neonatal morbidities remained significant once adjusted for birth weight, gestational age, and demographics, suggesting that the risk is mediated through IPI's effect on birth weight and gestational age.
- IPI remains a modifiable variable that could be an important target of intervention.

Future Directions

1. Consider additional analysis of relationship between IPI and maternal outcomes (e.g. pregnancy-related morbidites, route of delivery, obstetrical complications, etc.)

2. Examine models of preconception and interconception care to identify successful interventions to help women achieve optimal birth spacing.