# MCH Statistical Brief

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## Odds of Poor Birth Outcomes in Relation to Timing of the Ohio Smokefree Workplace Act

### Background

Birth weight and gestational age at birth are considered important predictors of infant survival and health, since low birth weight (LBW) (<2500 g) and preterm birth (gestation less than 37 weeks) place infants at substantial increased risk of subsequent mortality and ongoing health and developmental problems. At the population level, the rates of LBW and preterm birth are important indicators of a society's overall health. Maternal smoking during pregnancy is a well-established risk factor for both LBW and preterm birth[1]. Furthermore, pregnant women exposed to environmental tobacco smoke (ETS) have 20% higher odds of giving birth to a LBW infant when compared to women without this exposure[2]. The relationship between maternal ETS exposure and preterm birth is less clear, although a number of published studies have concluded that ETS exposure of pregnant women in the workplace is a hazard for the developing fetus[3].

According to the U.S. Census Bureau, two thirds of women who had their first child between 2001 and 2003 worked during pregnancy. This percentage has increased in the United States since the 1960's. The percentage of employed U.S. pregnant women who worked up through the month prior to their child's birth has similarly increased[4]. While the number of pregnant women exposed to ETS in the workplace is unknown, the fact that many women work throughout their pregnancies, combined with the known hazards of ETS exposure to the developing fetus, makes workplace ETS exposure during pregnancy an important public health concern.

To address the broader issue of known health hazards from ETS exposure, legislation banning smoking in the workplace and other public places has become more common in recent years, and improved health effects and lower smoking rates due to these measures have been demonstrated[5,6,7,8,9]. With regard to birth outcomes, a recent study comparing preterm birth rates in Colorado cities with and without smoking bans found lower preterm birth and maternal smoking rates in the city that had enacted a ban[8]. Likewise, preterm birth rates and maternal smoking rates declined in Ireland one year after introduction of a comprehensive Irish workplace smoking ban, although the rate of LBW increased [9].

The Ohio Smokefree Workplace Act was passed in late 2006 with a goal of protecting the public from ETS exposure in the workplace. Consequently, it was of interest to explore whether changes in birth outcomes occurred in Ohio subsequent to the statewide smoking ban. We therefore examined whether the odds of LBW and odds of preterm birth were reduced in Ohio residents after the Act's enforcement began in May 2007.

## Methods

Data from the Ohio Pregnancy Risk Assessment Monitoring System (PRAMS), covering Ohio resident women with singleton births from 2005 through 2009, were used for the assessment. Ohio PRAMS is a representative survey of Ohio resident mothers of live born infants and is part of a cooperative state/federal effort to carry out ongoing surveillance designed to better understand and ultimately prevent poor birth outcomes.

To establish pregnancies occurring before and after the ban, women were classified by timing of their last menstrual period (LMP), where women with LMP before May 1, 2007 were considered to have pre-smoke ban exposures while those with LMP on or after that date were considered to have post-smoke ban experiences. Low birth weight was classified as less than 2,500 g at birth while preterm birth was defined as gestational age less than 37 weeks.

Bivariate logistic regression methods for weighted survey data were used to calculate odds ratios of post- to pre- smoking ban exposures for outcomes of LBW, preterm birth, and LBW/term birth. Possible confounding factors were explored by assessing associations of covariates with outcome variables via bivariate logistic regression methods, and by examination of associations between potential confounders with the pre-post ban exposure variable. Maternal covariates that were examined included smoking during pregnancy, age, education, income, stressful events during pregnancy, race/ethnicity, WIC program participation, and pre-pregnancy body mass index. Multivariable models were then developed to control for possible confounding of the relationship between pre/post smoke ban exposure and birth outcomes.

## Results

Results of bivariate logistic regression analyses for LBW are found in Table 1. Without controlling for other factors, the odds of LBW did not differ between infants conceived pre- and post- smoking ban enforcement. Statistically significant associations with LBW were observed for all of the potential confounding variables examined.

**Table 1: Factors examined for an association with low birth weight (<2,500 g), unweighted frequencies, weighted percentages, and crude weighted odds ratios, singleton births, Ohio PRAMS, 2005-2009.**

unweighted n=6,872

| Variable | Low Birth Weight* # (%) | Crude Odds Ratio (95% CI) |
|---|---|---|
| **Last Menstrual Period with respect to Smoking Ban Enforcement** | | |
| Before May 1, 2007 | 1,633 (6.6) | Ref |
| On or After May 1, 2007 | 1,083 (6.9) | 1.1 (1.0 , 1.1) |
| **Maternal Age (years)** | | |
| <18 | 156 (11.6) | 1.9 (1.5 , 2.5) |
| 18-35 | 2,186 (6.5) | Ref |
| >35 | 268 (6.9) | 1.1 (0.9 , 1.3) |
| **Maternal Race/Ethnicity** | | |
| White, non-Hispanic | 1,462 (5.6) | Ref |
| Black, non-Hispanic | 1,097 (12.2) | 2.3 (2.2 , 2.5) |
| Hispanic | 50 (5.0) | 0.9 (0.6 , 1.2) |
| Other, non-Hispanic | 109 (7.9) | 1.4 (1.1 , 1.9) |
| **Maternal Education** | | |
| < =High School | 1,474 (8.8) | 1.8 (1.6 , 2.0) |
| >High School | 1,244 (5.1) | Ref |
| **Maternal Smoking During Pregnancy** | | |
| Yes | 680 (10.8) | 2.0 (1.7 , 2.3) |
| No | 1,851 (5.7) | Ref |

| Variable | Low Birth Weight* # (%) | Crude Odds Ratio (95% CI) |
|---|---|---|
| **Family Income** | | |
| Near or below 100% of poverty | 1,199 (9.4) | 1.9 (1.7 , 2.1) |
| Above 100% of poverty | 1,278 (5.2) | Ref |
| **Pre-pregnancy Body Mass Index** | | |
| <18.5 | 294 (11.6) | 1.9 (1.6 , 2.3) |
| 18.5-24.9 | 1,224 (6.5) | Ref |
| 25.0-29.9 | 573 (5.8) | 0.9 (0.8 , 1.0) |
| >30.0 | 600 (6.7) | 1.0 (0.9 , 1.2) |
| **Stressful Events in Pregnancy** | | |
| None | 544 (5.5) | Ref |
| One or More | 2,118 (7.1) | 1.3 (1.2, 1.5) |
| **WIC during Pregnancy** | | |
| No | 1,231 (5.4) | Ref |
| Yes | 1,429 (8.4) | 1.6 (1.4, 1.8) |

*****unweighted frequencies and weighted percentages

Table 2 presents results of analyses comparing distributions of potential confounders with pre/post ban timing. Maternal education was the only covariate significantly related to smoke ban timing, with a slightly greater percentage of more highly educated women found in the post ban period.

**Table 2: Distribution of risk factors for LBW, by timing of last menstrual period (pre and post smoking ban), unweighted frequencies, weighted percentages, and chi squared p values, singleton births, Ohio PRAMS, 2005-2009.**

unweighted n=6,872

| Variable | LMP Before* May 1, 2007 # (%) | LMP After* May 1, 2007 # (%) | Chi Squared P Value |
|---|---|---|---|
| **Maternal Age (years)** | | | |
| <18 | 193 (3.2) | 119 (3.8) | 0.53 |
| 18-35 | 3,468 (87.6) | 2,197 (86.4) | |
| >35 | 383 (9.2) | 265 (9.9) | |
| **Maternal Race/Ethnicity** | | | |
| White, non-Hispanic | 2,590 (77.5) | 1,468 (76.1) | 0.40 |
| Black, non-Hispanic | 1,366 (15.4) | 1,048 (16.0) | |
| Hispanic | 94 (3.1) | 65 (3.8) | |
| Other, non-Hispanic | 147 (4.0) | 94 (4.1) | |
| **Maternal Education** | | | |
| < =High School | 1,999 (46.9) | 1,209 (42.7) | **0.01** |
| >High School | 2,198 (53.1) | 1,466 (57.3)) | |
| **Maternal Smoking During Pregnancy** | | | |
| Yes | 818 (18.7) | 473 (20.3) | 0.39 |
| No | 3,254 (81.3) | 1,885 (79.7) | |
| **Family Income** | | | |
| Near or below 100% of poverty | 1,537 (34.7) | 1,060 (35.3) | 0.73 |
| Above 100% of poverty | 2,313 (65.3) | 1,410 (64.7) | |
| **Pre-pregnancy Body Mass Index** | | | |
| <18.5 | 343 (7.2) | 222 (7.2) | 0.20 |
| 18.5-24.9 | 1,955 (49.6) | 1,181 (46.7) | |
| 25.0-29.9 | 954 (22.9) | 596 (23.2) | |
| >30.0 | 902 (20.3) | 634 (22.9) | |
| **Stressful Events in Pregnancy** | | | |
| None | 954 (25.2) | 595 (24.9) | 0.06 |
| One or More | 3,150 (74.8) | 2,025 (75.1) | |
| **WIC during Pregnancy** | | | |
| No | 2,145 (57.5) | 1,316 (56.4) | 0.50 |
| Yes | 1,971 (42.5) | 1,312 (43.6) | |

*****unweighted frequencies and weighted percentages

Finally, results of the multivariable regression are found in Table 3. While most covariates remained statistically significantly associated with LBW, their presence in the model did not alter the observed relationship between smoke ban and LBW. Thus, there is no evidence from this assessment of a relationship between timing of smoking ban enforcement and odds of LBW. Similar results were observed for preterm births and LBW among term infants (not shown).

**Table 3: Final multivariable logistic regression model of putative association between last menstrual period occurring pre/post the Ohio statewide smoking ban and low birth weight, while controlling for other factors, Ohio PRAMS, 2005-09.**

**n=5,681**

| Variable | β | β Standard Error | Adjusted Odds Ratio | 95% Confidence Intervals for Odds Ratio |
|---|---|---|---|---|
| Intercept | -3.21 | 0.07 | 0.04 | 0.04 , 0.05 |
| **LMP on or after May 1, 2007** | **0.03** | **0.04** | **1.03** | **0.95 , 1.11** |
| Less than 18 years old | 0.50 | 0.17 | 1.64 | 1.17 , 2.31 |
| 35 years or older | 0.28 | 0.10 | 1.33 | 1.09 ,1.61 |
| High school or less | 0.30 | 0.07 | 1.35 | 1.18 , 1.55 |
| Smoke during pregnancy | 0.62 | 0.08 | 1.86 | 1.59 , 2.16 |
| Underweight | 0.34 | 0.12 | 1.41 | 1.12 , 1.78 |
| Overweight | -0.17 | 0.08 | 0.85 | 0.73 , 0.98 |
| Obese | -0.06 | 0.08 | 0.94 | 0.81 , 1.09 |
| Black, nonHispanic | 0.76 | 0.06 | 2.13 | 1.89 , 2.39 |
| Hispanic | -0.21 | 0.21 | 0.81 | 0.54 , 1.21 |
| Other, nonHispanic | 0.45 | 0.16 | 1.57 | 1.15 , 2.15 |
| Family income at or below 100% poverty | 0.21 | 0.08 | 1.24 | 1.06 , 1.45 |
| WIC during pregnancy | -0.08 | 0.08 | 0.92 | 0.79 , 1.08 |

## Conclusion

These results are limited by the facts that, 1) information was self-reported (which sometimes leads to underreporting of undesirable behaviors) and 2) no information was available on ETS exposure or employment of the mother during pregnancy. It is possible that different results may have been observed among subgroups of women employed during pregnancy in industries most likely impacted by the ban (such as in restaurants or bars). It is unknown what proportion of pregnant women worked in such jobs in Ohio. Thus, it is also unknown whether improvements in outcomes of these women could have been obscured by their incorporation into a larger group of women who were unexposed to ETS irrespective of the existence of a smoking ban.

Nevertheless, the Ohio PRAMS survey was expressly developed to focus on examination of risk factors for LBW. Thus, the sample size of women with LBW infants from this data source had adequate statistical power to permit assessment of these relationships. Furthermore, the size and direction of associations observed in the data between LBW and other known risk factors (e.g., smoking during pregnancy, education, race/ethnicity) were consistent with the published literature, lending support for the validity of the information from PRAMS.

In conclusion, no evidence of statewide improvement in odds of poor birth outcomes was observed from this analysis. Given that no information was available to assess industry of employment (or any employment) during pregnancy, a relationship between the ban and birth outcomes could not be examined among subgroups of pregnant women most likely to have been impacted by the ban, thereby limiting interpretation of these results.

## References


1. Hofhuis W, de Jongste JC, Merkus PJ. Adverse health effects of prenatal and postnatal tobacco smoke exposure on children. Arch Dis Child 2003; 88:1086–90.

2. The Health Consequences of Involuntary Exposure to Tobacco Smoke: 2006 Surgeon General's Report. http://www.cdc.gov/tobacco/data_statistics/sgr/2006/index.htm

3. Misra DP and Nguyen R. Environmental Tobacco Smoke and Low Birth Weight: A Hazard in the Workplace? Environmental Health Perspectives 1999; 107, Supplement 6:897-904.

4. U.S. Census Bureau News Release. Women more likely to work during pregnancy. 2008. http://www.census.gov/newsroom/releases/archives/employment_occupations/cb08-33.html

5. Centers for Disease Control and Prevention (CDC) (January 2009). Reduced hospitalizations for acute myocardial infarction after implementation of a smoke-free ordinance—City of Pueblo, Colorado, 2002–2006.*MMWR Morb. Mortal. Wkly. Rep.* **57** (51): 1373–7.

6. Naiman A, Glazier RH, Moineddin R. Association of anti-smoking legislation with rates of hospital admission for cardiovascular and respiratory conditions. *CMAJ* 2010; **182** (8): 761–7.

7. Hopkins DP, Razi S, Leeks KD, Priya Kalra G, Chattopadhyay SK, Soler RE. Smokefree policies to reduce tobacco use. A systematic review. *Am J Prev Med.* 2010; **38** (2 Suppl): S275–89.

8. American Public Health Association News Release. Citywide smoking ban contributes to significant decrease in maternal smoking, preterm births. 2010. http://www.apha.org/about/news/pressreleases/2010/maternal+smoking+prevalence.htm

9. Kabir Z, Clarke V, Conroy R, et.al. Low birthweight and preterm birth rates 1 year before and after the Irish workplace smoking ban. BJOG. 2009; 116(13):1782-7.

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