Effects of Smoking and Smoking Cessation during Pregnancy on Adverse Birth Outcomes in Rhode Island, 2012–2014

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Smoking is one of the most common preventable causes of poor pregnancy outcomes and is associated with maternal, fetal, and infant morbidity and mortality.[1-3] Smoking before pregnancy can cause reduced fertility, infertility, and ectopic pregnancy. Smoking during pregnancy increases the risk for pregnancy complications (e.g., placental previa, placental abruption, and premature rupture of the membrane) and poor infant outcomes (e.g., low birth weight, preterm birth, restricted fetal growth, sudden infant death syndrome (SIDS), born with a cleft lip or cleft palate, and preterm related death).[1-3] Maternal smoking after delivery increases an infant's risk for respiratory tract infections, ear infections, severe asthma, and death from SIDS through exposure to secondhand smoke.[1-3] In 2002, it was estimated that 5%–8% of preterm deliveries, 13%–19% of term low birth weight deliveries, 23%–34% of SIDS, and 5%–7% of preterm-related deaths were attributable to prenatal smoking in the United States.[4] Two Healthy People 2020 national health objectives address smoking and smoking cessation during pregnancy; 1) reducing the prevalence of cigarette smoking among pregnant women to 1.4% (MICH-11.3), and 2) increasing smoking cessation during pregnancy to 30.0% (TU-6).[5]

The purpose of this study was to examine the effects of smoking and smoking cessation during pregnancy on adverse birth outcomes in Rhode Island. In addition, it described the prevalence of and disparities in cigarette smoking during pregnancy.

METHODS

We analyzed aggregate data from the 2012-2014 Rhode Island Pregnancy Risk Assessment Monitoring System (PRAMS) (n=3,642; average weighted response rate=62.9%). PRAMS is a collaborative surveillance project of the Centers for Disease Control and Prevention (CDC) and state health departments, which collects state-specific, population-based data on maternal behaviors and experiences before, during, and shortly after pregnancy.[6] Self-reported survey data are linked to selected birth certificate data and are weighted to represent all women delivering live infants in Rhode Island.

To estimate the prevalence of prenatal smoking, and to determine prenatal smoking status, the following survey questions were analyzed: "Have you smoked any cigarettes in the *past 2 years*?" "In the *3 months before* you got pregnant, how many cigarettes did you smoke on an average day?" "In the *last 3 months* of your pregnancy, how many cigarettes did you smoke on an average day?" Prenatal smoking status was classified as "did not smoke during pregnancy," "smoked before pregnancy but quit smoking by the last 3 months of pregnancy" and "smoked throughout the pregnancy." Three measures of adverse birth outcomes collected from the birth certificate files were used in this study: low birth weight (<2,500 grams), preterm birth (<37 weeks' gestation), and small-for-gestational-age (<10th percentile). To identify disparities, the prevalence of prenatal smoking was examined by various socio-demographic characteristics (maternal age, race/ethnicity, education, marital status, household income, health insurance type, parity, and assistance from WIC program). These characteristics were also used as covariates in the logistic regression model.

All data analyses were performed using SUDAAN release 11.0,[7] which accounts for the complex sample design of PRAMS. Logistic regression was performed to assess the effects of smoking and smoking cessation during pregnancy on each measure of adverse birth outcomes, while controlling for all covariates. The p-values <.05 are considered statistically significant.

RESULTS

Prevalence of Smoking during Pregnancy, 2012–2014

Overall, 8.5% (95% CI: 7.5%-9.5%) of Rhode Island women who delivered a live infant between 2012 and 2014 smoked during the last 3 months of pregnancy. The prevalence of smoking during pregnancy varied significantly among populations (**Figure 1**). Women who were aged 20–29 years (11.1%), were White (10.0%), were non-Hispanic (9.9%), were unmarried (14.2%), were on WIC program (13.5%), were publicly insured (14.1%), were multiparous (10.5%), had < high school education (17.6%), had an annual household incomes < $26,000 (15.4%) were more likely to smoke during pregnancy, compared to their counterparts. None of the groups presented in Figure 1, except one group with an annual household income > $67,000, achieved the Healthy People 2020 goal of reducing the prevalence of cigarette smoking among pregnant women to 1.4%.[5]

Prenatal Smoking and Adverse Birth Outcomes, 2012–2014

Among women who delivered a live birth during 2012–2014, 80.5% (95% CI: 79.0%–81.9%) were classified as "did not smoke during pregnancy," 11.1% (95% CI: 10.0%–12.3%) were classified as "quit smoking during pregnancy," and 8.5% (95% CI: 7.5%–9.5%) as "smoked throughout the

Figure 1. Prevalence of smoking during the last 3 months of pregnancy by socio-demographic characteristics, Rhode Island women who delivered a live birth, RI PRAMS, 2012–2014 combined

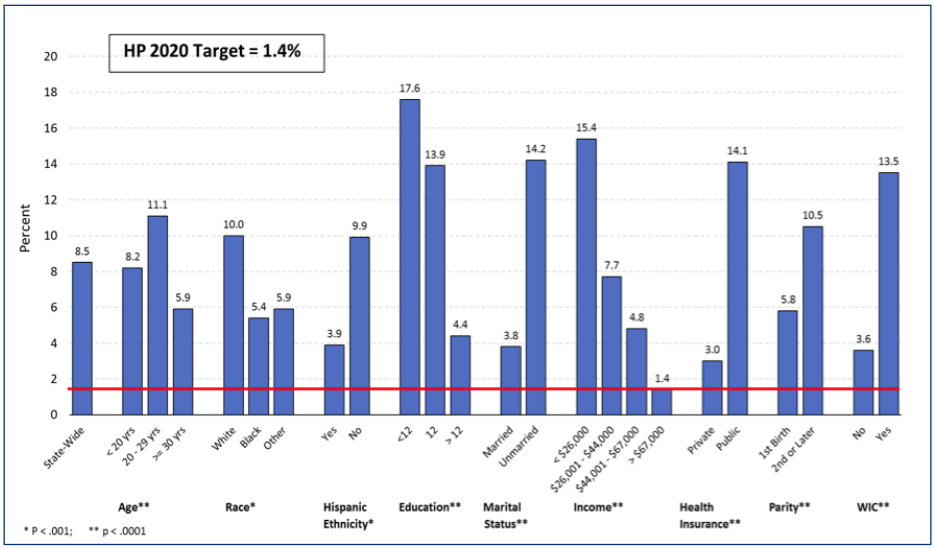

Figure 2. Prevalence of adverse birth outcomes by maternal smoking status during pregnancy, Rhode Island women who delivered a live birth, RI PRAMS, 2012-2014 combined

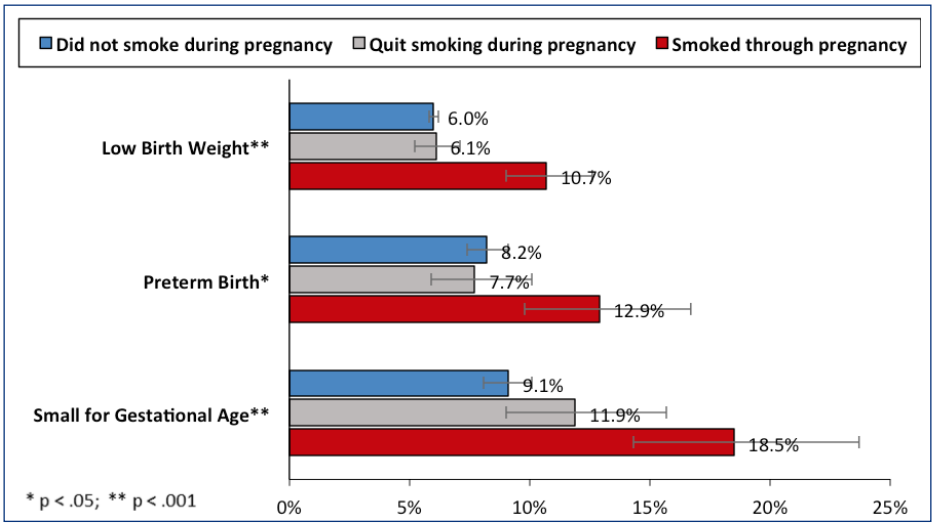

Table 1. Adjusted Odds Ratio (AOR) and 95% Confidence Interval (CI) for Each Adverse Birth Outcome, Rhode Island women who delivered a live birth, RI PRAMS, 2012–2014 combined

	Low Birth Weight		Preterm Birth		Small for Gestational Age	
	AOR	95% CI	AOR	95% CI	AOR	95% CI
Did not smoke during pregnancy	1		1		1	
Quit smoking during pregnancy	1.05	0.84-1.31	0.9	0.62-1.31	1.22	0.81-1.84
Smoked throughout pregnancy	2.04*	1.57-2.65	1.30	0.87-1.95	2.55*	1.65-3.94

* p<.0001
AOR: Adjusted Odds Ratio: Adjusted for Maternal Age, Race, Ethnicity, Education, Marital Status, Household Income, Health Insurance, Parity, and WIC participation.

pregnancy." During 2012-2014, 6.4% (95% CI: 6.3%–6.5%) of Rhode Island mothers had a low birth weight baby, 8.6% (95% CI: 7.9%–9.3%) had a preterm delivery, and 10.1% (95% CI: 9.2%–11.1%) had a small-for-gestational-age baby.

Figure 2 presents the prevalence of each adverse birth outcome in relation to prenatal smoking status. Compared to women who did not smoke during pregnancy, women who smoked throughout the pregnancy were significantly more likely to have a low birth weight baby (6.0% vs. 10.7%), a preterm baby (8.2% vs. 12.9%), and a small-for-gestational-age baby (9.1% vs. 18.5%). However, there were no significant differences between women who did not smoke during pregnancy and women who quit smoking during pregnancy in the prevalence of all three measures of adverse birth outcomes.

Table 1 presents the adjusted odds ratios (AOR) and 95% confidence intervals (CI) from the logistic regression analyses for each adverse birth outcome measure. After adjusting for all socio-demographic factors shown in Figure 1, women who smoked throughout the pregnancy had twice the odds of having a low birth weight baby (AOR=2.04; 95% CI=1.57-2.65; p<.0001) and 2.6 times the odds of having a small-for-gestational-age baby (AOR=2.55; 95% CI=1.65-3.94; p<.0001), compared with women who did not smoke during pregnancy. However, preterm birth became not significant when all covariates were controlled for. Consistent with the results in Figure 2, there were no significant differences between women who did not smoke during pregnancy and women who quit smoking during pregnancy in the odds of adverse birth outcomes for all three measures.

LIMITATIONS

The findings in this article are subject to at least two limitations. First,

the smoking data in this study relied on self-reporting. Pregnant women might under-report smoking and over-report quitting smoking during pregnancy. Second, the PRAMS sample includes only women who delivered a live infant, and excludes women who experienced a miscarriage or stillbirth that is likely related to smoking during pregnancy. Therefore, the actual prevalence of smoking among all pregnancies might be higher than the estimates presented here.

DISCUSSION

The main finding of this study is that although smoking during pregnancy significantly increases the risk for certain adverse birth outcomes, quitting smoking during pregnancy substantially reduces these risks. Women who smoked throughout their pregnancy, compared with women who did not smoke during pregnancy, had significantly higher odds of poor birth outcomes (e.g., low birth weight and small-for-gestational-age). However, when comparing women who quit smoking during pregnancy with women who did not smoke, no differences were found in the odds of low birth weight, preterm birth, and small-for-gestational-age. The results of this study provide a compelling message that smoking cessation is not only possible, but critical, for pregnant smokers to reduce the risk of adverse birth outcomes. In addition, our data also show that 1 in 12 Rhode Island women who delivered a live infant during 2012-2014 smoked in the last 3 months of pregnancy, and there were significant disparities among populations in prenatal smoking prevalence.

These new data can be strategically used by providers to communicate the benefits of quitting, increase motivation to quit, and engage pregnant smokers in supportive services that help them quit and stay quit. For example, the Rhode Island Tobacco Control Program coordinates with the WIC program to promote motivating cessation messages that link pregnant smokers to free, evidence-based telephonic counseling specifically tailored to the needs of pregnant women. Through the Rhode Island Quitline (1-800-Quit-Now), women can access extended counseling during pregnancy and receive relapse prevention counseling through post-partum. When offering cessation services to patients, providers can refer pregnant smokers to the Quitline by fax referral so they have extra support.

Pregnancy appears to motivate women to quit smoking: 55% of Rhode Island women who smoked before pregnancy stopped smoking by the last 3 months of pregnancy in 2014.[8] While effective interventions such as motivational interviewing, brief cessation counseling (the 5 A's) and supplementary referral to the Quitline help many women, some pregnant women are highly addicted to nicotine and require consistent intervention at each health care encounter.[3] Health care providers can help increase smoking cessation among pregnant women by routinely integrating tobacco use assessment and cessation interventions into each prenatal care visit.[3] As most women have more than 10 prenatal care visits during pregnancy, providers have multiple opportunities (from the first prenatal care visit throughout the course of pregnancy) to motivate smokers to quit and provide effective cessation interventions.[3] It is also recommended that since nearly 40% of pregnancies in Rhode Island are unintended, public health efforts should target all reproductive-age women, regardless of pregnancy status or pregnancy intention, to refrain from smoking to reduce maternal, fetal, and infant morbidity and mortality.

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The authors have no financial interests to disclose.

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