

Maternal Smoking

Introduction:

The adverse reproductive effects of prenatal tobacco use for both mother and baby are well documented in medical literature. Tobacco use during pregnancy remains one of the single most important preventable causes of poor birth outcomes. Women who use tobacco during pregnancy are more likely to experience pregnancy complications such as placenta previa and abruption, miscarriage, ectopic pregnancy, and premature rupture of membranes (PROM). The causal link between tobacco use during pregnancy and poor infant outcomes is even stronger, with higher rates of preterm delivery, low birth weight, stillbirth, and neonatal and perinatal mortality. It is also well established that second-hand smoke can exacerbate many common childhood illnesses including otitis media, new and complicated cases of asthma, bronchitis, pneumonia, wheezing, and lower respiratory illness.¹

The economic impact of prenatal tobacco use on the cost of health care is immense. The costs of neonatal conditions in Oklahoma attributable to tobacco use during pregnancy have been estimated at \$5.7 million per year, mostly due to increased need for Neonatal Intensive Care Unit (NICU) services.² Additionally, there are the indirect costs in terms of years of life lost due to infant mortality and loss of productivity of the mother. Over 1,150 years of potential life are lost each year in Oklahoma due to smoking during pregnancy. Estimates show that tobacco use costs about \$908 million, about half of which is paid for by Oklahoma taxpayers.² Countering that burden with treatment for nicotine addiction has been shown to be cost effective: for every dollar spent on tobacco cessation intervention, three dollars are saved in medical costs.³

Pregnancy presents an opportunity to intervene with women who use tobacco because they are generally more motivated to quit smoking for the sake of their babies' health. Providers are able to reach smokers more easily during this time period because most pregnant women and their families have regular contact with the health care system.

This PRAMISGRAM will examine maternal smoking in Oklahoma and its relationship with low birth weight and will offer recommendations for actions to be taken to improve cessation efforts in the state.

In Oklahoma

- Approximately 30.4% of Oklahoma mothers smoked during the three months prior to pregnancy.
- Eighteen percent of women in Oklahoma smoked during the last three months of their pregnancy.
- Those mothers most likely to continue smoking during pregnancy were Non-Hispanic, white, American Indian, had less than a high school education, or received Medicaid-funded maternity services.
- Mothers who smoked during pregnancy were twice as likely to have a low birth weight infant as mothers who did not smoke.
- Fifty-nine percent of women who quit during pregnancy began smoking again postpartum.

Methods:

PRAMS data for years 2000-2003 were examined. Population estimates, 95% confidence intervals, and logistic regressions were produced using SUDAAN statistical software. Results were said to be statistically significant at $p < .05$. Multivariate logistic regression analyses were used to assess smoking behavior (smoker vs. non-smoker) during the third trimester and birth weight (low $< 2,500$ gms vs. normal $\geq 2,500$ gms) among mothers having singleton births. The effects of covariates like age, race, education, marital status, adequacy of prenatal care (using the Kotelchuck Index), stress levels, participation in WIC (the Special Supplemental Nutrition Program for Women, Infants, and Children), key morbid conditions, smoking and federal poverty level were assessed. Morbidity included conditions like high blood pressure (including preeclampsia or toxemia) or retained water (edema), vaginal bleeding, problems with placenta (such as abruption placentae, placenta previa) and premature rupture of membranes (PROM). The logistic regression models were selected by backward

Table 1. Characteristics of mothers that reported smoking Before¹, During², After³ pregnancy: Oklahoma PRAMS 2000-2003

Maternal Characteristic	Before		During		After	
	%	95% CI	%	95% CI	%	95% CI
Overall	30.4	(28.7, 32.2)	18.4	(17.0, 19.8)	26.2	(24.6, 27.8)
Age						
<20	43.1	(38.9, 47.3)	24.1	(20.7, 27.9)	38.2	(34.3, 42.3)
20-24	36.5	(33.0, 40.1)	20.9	(18.0, 24.0)	30.6	(27.3, 34.1)
25-29	25.5	(22.5, 28.6)	15.8	(13.4, 18.5)	21.6	(18.8, 24.6)
30 or older	19.7	(17.1, 22.6)	13.8	(11.6, 16.5)	16.7	(14.3, 19.5)
Education						
<HS	43.3	(39.3, 47.4)	31.0	(27.4, 34.9)	40.6	(36.7, 44.6)
HS	37.4	(34.4, 40.4)	22.0	(19.5, 24.6)	32.5	(29.7, 35.4)
>HS	17.6	(15.6, 19.8)	8.3	(6.9, 9.9)	12.7	(11.0, 14.7)
Race						
White	31.5	(29.6, 33.5)	9.2	(7.6, 20.9)	26.7	(24.9, 28.6)
African American	18.7	(14.3, 24.1)	13.3	(9.6, 18.1)	17.9	(13.6, 23.1)
American Indian	37.3	(31.7, 43.4)	19.0	(14.7, 24.3)	32.9	(27.6, 38.8)
Ethnicity						
Hispanic	13.2	(9.6, 17.8)	5.5	(3.3, 9.0)	11.1	(7.9, 15.5)
Non-Hispanic	32.4	(30.6, 34.3)	19.8	(18.3, 21.4)	27.9	(26.2, 29.6)
Medicaid Recipient						
No	20.1	(18.1, 22.1)	10.2	(8.8, 11.9)	16.6	(14.8, 18.5)
Yes	41.9	(39.2, 44.6)	27.1	(24.7, 29.5)	36.5	(34.0, 39.2)
PNC (Kotelchuck Index)						
Inadequate/Intermediate	35.4	(32.0, 39.0)	22.6	(19.7, 25.8)	31.5	(28.3, 35.0)
Adequate	27.7	(25.2, 30.4)	15.8	(13.8, 18.1)	23.4	(21.0, 25.9)
Adequate Plus	30.3	(27.2, 33.5)	18.3	(15.8, 21.1)	25.7	(22.8, 28.8)
Pregnancy Intendedness						
Unintended	38.8	(36.2, 41.4)	23.5	(21.3, 25.8)	33.6	(31.1, 36.1)
Intended	22.2	(20.1, 24.4)	13.4	(11.7, 15.2)	18.8	(16.9, 20.9)

¹Reported Smoking during three months before conception

²Reported smoking during last three months of pregnancy

³Reported smoking at the time of the PRAMS survey (2-6 months postpartum)

selection method. The models fit the data adequately, as determined by Hosmer-Lemeshow goodness-of-fit tests. Women aged 20 or younger were excluded from the regression analyses so that all respondents would have an equal opportunity to achieve all levels of education.

Results

Overall, approximately 30% of women with a recent live birth in Oklahoma smoked cigarettes in the three months prior to becoming pregnant. Of those women who smoked during this period, 42% quit smoking by their last three months of pregnancy. Yet nearly 1 in 5 pregnant Oklahomans continued to smoke into their third trimester (18.4%). Moreover, postpartum recidivism rates were high; almost 59% of women who quit during pregnancy resumed smoking after delivery. More than a quarter (26.2%) of mothers reported smoking 2-6 months postpartum.

The Pregnancy Risk Assessment Monitoring System (PRAMS) is an ongoing, population-based study designed to collect information about maternal behaviors and experiences before, during and after pregnancy. On a monthly basis, PRAMS samples between 200 and 250 recent mothers from the Oklahoma live birth registry. Mothers are sent as many as three mail questionnaires seeking their participation, with follow-up phone interviews for non-respondents. A systematic stratified sampling design is used to yield sample sizes sufficient to generate population estimates for groups considered at risk for adverse pregnancy outcomes. Information included in the birth registry is used to develop analysis weights that adjust for probability of selection and non-response. Initially, 9,736 mothers, in 2000-2003, were sampled and sent the survey. Of these, 7,680 responded yielding a response of 78.9%.

Table 1 provides summary data for those mothers who reported smoking three months before pregnancy, during their third trimester, and 2-6 months postpartum. These data show those mothers most at risk for smoking before pregnancy were women less than 20 years of age (43.1%), those with less than a high school education (43.3%), or women who were American Indian (37.3%). Women who reported receiving Medicaid benefits (41.9%), those with inadequate or intermediate levels of prenatal care (35.4%), and those with unintended pregnancies (38.8%) were also more likely to smoke prior to pregnancy. Furthermore, with the exception of American Indian mothers, whose smoking rate (19.0%) fell to a level similar to white mothers (19.2%) during the third trimester of pregnancy, these groups were at greatest risk for smoking across each of the measured time periods.

Table 2 summarizes results from a logistic regression model predicting the probability of smoking during the third trimester. The multivariate model included variables for age, race, education, marital status, ethnicity, WIC participation, Medicaid status, pregnancy intendedness, adequacy of prenatal care, and stress levels.

Race, ethnicity, and socioeconomic factors appear to contribute to the risk of smoking while pregnant. African American mothers showed significantly lower odds of smoking than white mothers (Odds Ratio (OR)=0.33). Hispanic mothers were at significantly lower odds (OR=0.09) for prenatal smoking as well. Mothers with lower levels of education (<HS, OR=5.33; HS, OR=2.65) had significantly higher odds of smoking during pregnancy compared to mothers who extended their education beyond high school.

Table 2. Smoking during third trimester of pregnancy among Oklahoma mothers: Oklahoma PRAMS 2000-2003

Characteristic	Odds Ratio (OR)	95% CI
Age		
21-24	0.80	(0.56, 1.14)
25-29	1.05	(0.73, 1.50)
30 or older	reference	
Race		
African American	0.33	(0.20, 0.54)
American Indian	0.72	(0.45, 1.14)
Other	0.47	(0.16, 1.44)
White	reference	
Education		
<HS	5.33	(3.53, 8.03)
HS	2.65	(1.94, 3.62)
>HS	reference	
Not Married	2.00	(1.47, 2.73)
Hispanic	0.09	(0.04, 0.21)
WIC Participant	1.03	(0.74, 1.44)
Medicaid Recipient	1.68	(1.19, 2.36)
Unintended Pregnancy	1.08	(0.81, 1.43)
Kotelchuck Index		
Intermediate/Inadequate	1.16	(0.84, 1.61)
Adequate	reference	
Adequate Plus	1.27	(0.93, 1.72)
Stress Level		
No Stress	reference	
Level 1	1.40	(0.85, 2.31)
Level 2	2.18	(1.33, 3.57)
Level 3-4	3.45	(2.13, 5.58)
Level 5 or higher	4.32	(2.60, 7.18)

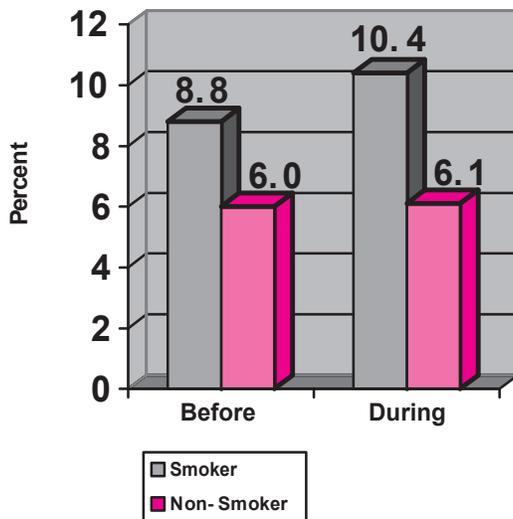
Hosmer-Lemeshow $p > .05$

Mothers who were not married (OR=2.00) or who were recipients of Medicaid benefits during their pregnancies (OR=1.68) experienced comparatively higher odds than did their respective counterparts. Stressors in a woman's life may also impact the likelihood of smoking while pregnant. A gradient of higher odds for prenatal smoking was observed among mothers experiencing two or more stressors compared to mothers reporting no stress during the time of pregnancy.

Maternal age, WIC program participation, pregnancy intendedness, and levels of prenatal care were not found to be associated with smoking during the third trimester of pregnancy. Hosmer-Lemeshow goodness-of-fit tests were not significant indicating an adequate model fit to the data.

Among all women, those that reported smoking before or during pregnancy were more likely to give birth to a low birth weight baby than non-smokers (8.9% vs. 6.0%). Figure 1 displays the percentage of mothers who delivered a low birth weight infant for each pre-delivery period for which smoking behavior was measured.

Figure 1. Low birth weight among women who smoked before and during pregnancy: Oklahoma PRAMS 2000-2003



A logistic regression was performed to predict the probability of delivering a low birth weight infant. Only singleton births were included. This regression model included variables for age, race, education, marital status, ethnicity, WIC participation, Medicaid status, pregnancy intendedness, adequacy of prenatal care, presence of morbid conditions, and smoking before or during pregnancy.

Five factors appear to influence the probability of delivering an infant weighing less than 2,500 grams in Oklahoma: maternal smoking, maternal morbidity, race, education, and level of prenatal care. Controlling for possible confounding variables, smoking either before or during pregnancy was found to be associated with low birth weight

Table 3. Low Birth Weight among Oklahoma mothers delivering a singleton birth: Oklahoma PRAMS 2000-2003

Characteristic	Odds Ratio (OR)	95% CI
Age		
21-24	0.81	(0.65, 1.00)
25-29	0.81	(0.66, 1.00)
30 or older	reference	
Race		
African American	2.22	(1.64, 2.99)
American Indian	1.03	(0.77, 1.38)
Other	1.99	(1.23, 3.22)
White	reference	
Education		
<HS	1.66	(1.26, 2.18)
HS	1.24	(1.03, 1.50)
>HS	reference	
Not Married	1.14	(0.92, 1.41)
Hispanic	1.20	(0.89, 1.63)
WIC Participant	0.83	(0.67, 1.02)
Medicaid Recipient	1.15	(0.94, 1.41)
Unintended Pregnancy	1.06	(0.89, 1.26)
Kotelchuck Index		
Intermediate/Inadequate	1.39	(1.12, 1.72)
Adequate	reference	
Adequate Plus	2.89	(2.41, 3.46)
Presence of Morbid Conditions	4.30	(3.67, 5.03)
Smoker	1.60	(1.32, 1.94)

Hosmer-Lemeshow $p > .05$

(OR=1.60; Table 3). Mothers who reported experiencing one or more morbidity conditions were shown to have an odds ratio more than four times higher (OR=4.30) than mothers not reporting these conditions. Several of these morbidity conditions (placenta previa and abruption, PROM) have been linked to maternal smoking in research¹. African American women, women with less than a high school education, women with inadequate/intermediate and adequate plus levels of prenatal care were also at higher risk for delivering a low birth weight infant. Hosmer-Lemeshow goodness-of-fit tests were not significant indicating an acceptable model fit to the data.

Discussion:

Maternal tobacco use adversely impacts the health of mother, fetus and infant. Nationwide, the percentage of women who smoke while pregnant is 11%¹. In spite of the known health risks, approximately one out of every five pregnant women in Oklahoma smoked during their third trimester. And, although many women quit smoking while they were pregnant, 59% of those who quit resumed their cigarette use between 2-6 months postpartum.

Women who smoked before or during pregnancy were at a higher risk for delivering a low birth weight infant compared to nonsmokers. Quitting at any time during pregnancy, even after the first trimester, can improve the baby's growth and lower that risk¹. Cessation interventions provide financial benefit in addition to creating a healthier maternal and child population. Research indicates that smoking cessation programs targeted at pregnant women can save as much as \$6 for each \$1 spent.⁴

Brief cessation counseling sessions delivered by a trained

provider with the provision of pregnancy specific self-help materials have been shown to significantly increase rates of cessation among pregnant smokers. This best practice smoking cessation intervention is also known as the 5 A's, which stands for ASK, ADVISE, ASSESS, ASSIST, and ARRANGE. Meta analyses have demonstrated that among women who smoke less than 20 cigarettes per day, this brief intervention can increase rates of cessation by 30% to 70%.^{5,6} Moreover, there is strong evidence to support the use of additional treatment strategies, such as telephone counseling and effective pharmacological agents for women who may need more assistance with quitting.⁷

Not only can the smoking habits of the mother harm both the mother and the infant, habits of other family members can also put them at risk. Non-smoking pregnant women exposed to secondhand smoke are at a higher risk for poor birth outcomes compared to women with little or no secondhand smoke exposure.⁸ And, a growing body of research on infants who are exposed to smoke documents the increased risks for lower-respiratory illnesses (such as bronchitis and pneumonia) and ear infections when compared to infants with no smoke exposure. These infants are also at a higher risk for SIDS and asthma later in life.¹ Because of this, secondhand smoke must also be a focus of anticipatory guidance for pregnant and parenting women and their families.

Several limitations for this study exist. All responses are self-reported and are subject to recall bias and social desirability bias. Due to the limitations of surveillance research, cause and effect cannot be established, only relationships and associations.

Recommendations

- Offer effective smoking cessation interventions to pregnant smokers that exceed the minimal advice to quit. Healthcare providers have a responsibility to provide accurate information on the risks smoking poses to the health of the pregnant smoker and the fetus, as well as to those around them. Comprehensive, free online CME training on the 5 A's can be found at <http://iml.dartmouth.edu/education/cme/Smoking/index.html>
- Assess for relapse. Healthcare providers should assess smoking status at each visit and use relapse prevention strategies recognizing that patients may minimize or deny their tobacco use. This will help to minimize the possibility of relapse during the postpartum period.
- Increase efforts to identify underlying factors that contribute to increased tobacco use during and after pregnancy. Health-care providers need to be particularly alert when caring for disparately affected populations.
- Use support therapy when needed. Pharmacotherapy and/or nicotine replacement therapy should be considered when the likelihood of quitting, with its potential benefits, outweighs the risks of the therapy and continued smoking.
- Provide more targeted intervention and discussion with

mothers and family members about the dangers of secondhand smoke and what they can do to limit exposure.

- Encourage the use of The Oklahoma Tobacco Helpline 1-800-QUIT NOW (1-800-784-8669).

References

1. March of Dimes. Smoking During Pregnancy. Accessed on September 30, 2005. Obtained from http://www.marchofdimes.com/professionals/14332_1171.asp.
2. Centers for Disease Control and Prevention. Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC): Adult SAMMEC and Maternal and Child Health (MCH) SAMMEC software, 2002c. Accessed on September 15, 2005. Obtained from <http://www.cdc.gov/tobacco/sammec>.
3. Marks, JS, Koplan, JP, Hogue CJR, Dalmat ME. A cost-benefit/cost-effectiveness analysis of smoking cessation for pregnant women. *American Journal of Preventive Medicine* 1990; 6(5): 282-9.
4. National Center For Chronic Disease Prevention and Health Promotion. Coverage For Tobacco Use Cessation Treatments. Accessed 12/20/2005. Obtained from http://www.cdc.gov/tobacco/educational_materials/cessation/page2.html
5. Wisborg, K. et al. 2000. A prospective study of smoking during pregnancy and SIDS. *Arch Dis Child*. 83: 203-206.
6. Melvin C, Dolan Mullen P, Windsor RA, Whiteside HP, Goldenberg RL. Recommended cessation counseling for pregnant women who smoke: a review of the evidence. *Tobacco Control* 2000; 9: 1-5.
7. Fiore MC, Bailey WC, Cohen SJ, et al. Treating tobacco use and dependence. Clinical practice guideline. Rockville, MD: U.S. Department of Health and Human Services. Public Health Service, June 2000.
8. Grant, SG. Qualitatively and quantitatively similar effects of active and passive maternal tobacco smoke exposure on in utero mutagenesis at the HPRT locus, *BMC Pediatrics* 2005, 5:20. Accessed October 1, 2005. Obtained from <http://www.biomedcentral.com/1471-2431/5/20/abstract>.

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