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Expansion of Medicaid Covered Smoking Cessation Services: Maternal Smoking and Birth Outcomes

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Objective: To assess whether Medicaid coverage of smoking cessation services reduces maternal smoking and improves birth outcomes.
Methods: Pooled, cross-sectional data for 178,937 women with live births from 1996 to 2008, who were insured by Medicaid in 34 states plus New York City, were used to analyze self-reported smoking before pregnancy (3 months), smoking during the last 3 months of pregnancy, smoking after delivery (3-4 months), infant birth weight, and gestational age at delivery. Maternal socio-demographic and behavior variables from survey data and birth outcomes from vital records were merged with annual state data on Medicaid coverage for nicotine replacement therapies (NRT), medications and cessation counseling. Probit and OLS regression models were used to test for effects of states' Medicaid cessation coverage on mother's smoking and infant outcomes relative to mothers in states without coverage.
Results: Medicaid coverage of NRT and medications is associated with 1.6 percentage point reduction ($p<.05$) in smoking before pregnancy among Medicaid insured women relative to no coverage. Adding counseling coverage to NRT and medication coverage is associated with a 2.5 percentage point reduction in smoking before pregnancy ($p<.10$). Medicaid cessation coverage during pregnancy was associated with a small increase (<1 day) in infant gestation ($p<.05$).
Conclusions: In this sample, Medicaid coverage of smoking cessation only affected women enrolled prior to pregnancy. Expansions of Medicaid eligibility to include more women prior to pregnancy in participating states, and mandated coverage of some cessation services without co-pays under the Affordable Care Act (ACA) should reduce the number of women smoking before pregnancy.

Keywords: Medicaid, Maternal and Perinatal Care and Outcomes, Substance Abuse: Alcohol / Chemical Dependency / Tobacco, Observational Data / Quasi-Experiments

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Introduction

Significant declines in prenatal smoking over the last decade have brought the U.S. closer to its Healthy People 2020 goal of reducing the prevalence of cigarette smoking among pregnant women to 1% (U. S. Department of Health and Human Services, 2013), yet smoking during pregnancy remains unacceptably high at 10–12% (Tong, Jones, Dietz, D'Angelo, & Bombard, 2009). Smoking among pregnant women covered by Medicaid is even higher, with 21% of these women smoking during the last 3 months of pregnancy compared to only 6% among those privately insured (PRAMS, 2008). Smoking during pregnancy increases the risk of fetal growth restriction and preterm delivery, and the higher rate of smoking among women insured through Medicaid has implications for both health and medical costs (U.S. Department of Health and Human Services, 2010, 2006, 2004). Indeed, prenatal smoking is associated with 5%–8% of preterm deliveries and 13%–19% of term, low birth weight deliveries in the U.S. (Dietz, et al., 2010). Medicaid insured over 40 percent of all births in the majority of states in 2009 (Kaiser Family Foundation [KFF], 2009), and more than two-thirds of total infants' costs at delivery attributable to maternal smoking were paid by the Medicaid program (Adams, Melvin, Raskind-Hood, Joski, Galactionova. (2011). Thus, reducing smoking among women covered by Medicaid could save tax payers money and improve the health of women and infants.

Findings from clinic-based trials and population-based policy evaluations indicate that reduced out-of-pocket costs for both cessation counseling and medications have been effective in increasing the number of tobacco users who quit (CDC, 2012). Several studies have evaluated cessation coverage for Medicaid populations of both men and women. Earlier studies using the Current Population Survey found Medicaid coverage associated with increased odds of intention to quit and quit attempts among Medicaid insured enrollees (Liu, 2010, 2009). This association was no longer statistically significant when cigarette taxes were accounted for in one study (Liu, 2010); the other did not control for taxes (Liu, 2009). One study examined the effect of mandated coverage of tobacco cessation for the Massachusetts Medicaid population in 2006 and found that the smoking prevalence significantly decreased from 38.3% in the pre-benefit period compared to 28.3% in the post-benefit period, representing a decline of 26 percent (Land et al., 2010). Two previous studies have focused solely on women before, during, or after pregnancy. An earlier study (Petersen, Garrett, Melvin, & Hartmann, 2006) linked 1998 coverage cessation data to 1998–2000 PRAMS data and found that quit rates were significantly higher in states with Medicaid coverage of pharmacotherapies or counseling than in states without cessation service coverage. However, this analysis was limited to only one year of coverage data, and only a few states changed policies during their short study period. The second study linked PRAMS data to state data on cigarette taxes/prices and smoke-free indoor air laws for all women with recent births 2000–2005; findings indicated that both types of policies increased quits by the 3rd trimester; this study did not analyze Medicaid coverage (Adams, Markowitz, Kannan, Dietz,

Tong, & Malarcher, 2012). The present study adds to this literature by examining the effects of Medicaid coverage of cessation services for women on Medicaid before or during pregnancy in a current, twelve year time period while also controlling for state variation in cigarette prices and smoke free indoor air laws.

Since 1998, almost half of the states have expanded Medicaid coverage of some form of smoking cessation services (CDC, 2010). As of the end of our study period (2009), 47 state Medicaid programs provided tobacco-dependence treatment coverage for some enrollees, and 38 covered at least one treatment for both fee-for-service and managed care enrollees (CDC, 2010).Yet, Medicaid coverage of cessation services was less than comprehensive in most states as only eight state programs offered coverage of all FDA-approved medications and some form of cessation counseling for all Medicaid enrollees (CDC, 2010).

Section 4107 of the Affordable Care Act (ACA) requires states, as of October 1, 2010, to provide Medicaid coverage for pregnant women without cost sharing of counseling and pharmacotherapy for cessation of tobacco use as recommended by the 2008 Public Health Service (PHS) guidelines or any subsequent modification of these guidelines (Mann 2011). The PHS guidelines provide recommendations designed to assist clinicians in delivering and supporting effective treatments for tobacco use and dependence. The PHS recommended that, "whenever possible pregnant smokers should be offered person-to-person psychosocial interventions that exceed minimal advice to quit" (Fiore et al., 2008). These guidelines also recommended providing tobacco dependence treatments (both medication and counseling) as a paid or covered benefit by health insurance plans since this has been shown to increase the proportion of smokers who use cessation treatment, attempt to quit, and successfully quit (Fiore et al., 2008). Finally, a Cochrane review found that full payment of cessation services was more effective than no or partial payment on prolonged abstinence rates (Reda, Kaper, Fikretler, Severens, & van Schayck, 2009).

Current Medicaid policies make many women at a state's near-poor income eligibility level, eligible only when pregnant. These income eligibility levels vary across the states. Under ACA, Medicaid eligibility will be extended to all those under 133% of the Federal Poverty Level (138% with income disregard) regardless of pregnancy. In the 24 states (plus DC) choosing to participate in the ACA Medicaid expansion at this time (KCMU, 2013), there will be a sizeable reduction in the proportion of Medicaid women entering pregnancy from an uninsured status (Adams, Gavin, Handler, Manning, Raskind-Hood, 2003) and an increase in access to smoking cessation services before pregnancy. Assessing the effect of previous expansions of Medicaid coverage for smoking cessation services on women's smoking behavior before and during pregnancy, as well as on birth outcomes, will help us understand the potential impact of ACA. This study addresses the following research questions:

- Does Medicaid coverage of smoking cessation services reduce the prevalence of smoking among Medicaid insured women before, during, and after pregnancy relative to having no coverage?

- Does cessation coverage have different effects on smoking based on *when* the woman was enrolled in Medicaid (e.g., prior to pregnancy or during pregnancy)?
- Does cessation coverage improve the birth outcomes among Medicaid insured women?

This study analyzes Pregnancy Risk Assessment Monitoring System (PRAMS) data for 1996 through 2008 for states with and without expansion of Medicaid coverage of smoking cessation services. PRAMS data are the only source of data on smoking behavior and insurance coverage before, during, and after delivery for a relatively large sample of women; it also oversamples low-income women.

Methods

Data

The PRAMS surveillance system is a joint project of the Centers for Disease Control and Prevention (CDC) and state health departments to collect data on maternal attitudes and experiences before, during, and shortly after pregnancy for a sample of U.S. live births (CDC, 2012). Birth mothers were selected using a stratified sampling design with a random start using birth certificate files; selected variables from birth certificate data were linked to the survey. States over-sampled women at risk for adverse pregnancy outcomes, defined as women with low birth weight infants or of minority race/ethnicity. Sampled mothers were sent a self-administered questionnaire two to six months after delivery, and after repeated mailings, non-respondents were followed up by telephone. Annual state sample sizes ranged from 1,300 to 3,000 women with the average response being 4 months after delivery. The PRAMS program allows data from states to be analyzed only when response rates reach certain levels: a 70% response rate from 1996 to 2006 and a 65% response rate from 2007 to 2008.

Since 1998, data on Medicaid coverage of cessation services is collected online and through follow-up phone surveys of state Medicaid program staff, and confirmed with supporting documentation, or secondary respondents by researchers at the University of California, Berkeley (CDC, 2010). These data were provided to us by UC Berkley researchers in Excel format documenting the first year of coverage by state and type of cessation service. Data on state/year of coverage from the Excel sheet was compared to MMWR publications on State Medicaid Coverage for Tobacco Dependence Treatments, resulting from the UC Berkeley survey work (CDC, 2001, 2009), to confirm the dates/years of coverage and to create an additional variable: 'pregnancy only' individual and group counseling year of coverage. From this comparison, we altered the data in the Excel sheet. Specifically, bupropion coverage in Massachusetts was altered to reflect 2006 as the expansion year (CDC, 2006), and both individual and group cessation coverage during pregnancy in Mississippi was changed to reflect

2005 (CDC, 2008) as the expansion year. These updated data were linked to the PRAMS data for the current analysis.

Data on Medicaid coverage of nicotine replacement therapy (NRT) of any form (e.g., gum, patch, spray, inhaler, lozenge), any medications (e.g., bupropion, varenicline), and individual or group counseling were used to create binary indicator variables (yes/no) for each state and year. Based on states' most common combinations of coverage, we define mutually exclusive categories: (1) states with comprehensive coverage including NRT, medications, and counseling; (2) states with coverage including NRT and medications, but no counseling; (3) states with some form of coverage of NRT, medications, and counseling, but not already represented in categories 1 or 2; and (4) states with no coverage of any type. Group 4 serves as the omitted reference category.

These state-based coverage indicators were merged to the PRAMS records based on the woman's state of residence, date of conception, and date of delivery. Conception month was estimated using delivery month and gestational age (in weeks) from the birth certificate. If the month prior to conception was in the first 6 months of the year (e.g., 2000), her state's prior year's cessation coverage (1999) was assigned to her record; if the month prior to conception was in the last six months of 2000, her state's policies for 2000 were assigned. This same procedure was used to assign cessation policies for third trimester (delivery month minus three months) and post-delivery (delivery month plus three months).

Sample

We obtained data for 34 states that had weighted PRAMS data in some or all of the 1996–2008 study period (AK, AL, AR, CO, FL, GA, HI, IL, LA, MA, MD, ME, MI, MN, MO, MS, MT, NC, ND, NE, NJ, NM, NY[upstate], OH, OK, OR, RI, SC, TN, UT, VT, WI, WV, WY) plus New York City. We note that 24 of the study states are in the sample for over half of the 1996–2008 study period, and that births in the study states with 2008 data represent approximately 43% of all U.S. live births in that year.

Women were included in the study sample based on insurance data from PRAMS for the month pre-pregnancy, during their prenatal period, and at delivery. The total number of unique women with Medicaid coverage during the study is 178,937,[1] although some analyses are based on sub-samples of these women based on the timing of their Medicaid enrollment. We include indicators for missing values in our independent variables so we do not further lose observations. We use our full sample of women in estimating the models on smoking behavior, but restrict the sample to mothers of singletons when analyzing birth outcomes to avoid a potential bias from secular trends in low birth weight related to multiple births.

From our total sample (n = 178,937), we use three Medicaid groups based on the timing of enrollment in Medicaid: (1) women insured by Medicaid before pregnancy (n=61,977), (2)

[1]Women with missing values on critical dates (e.g., delivery month), smoking behavior, or cigarette policies are deleted from the analysis.

women who enter Medicaid during pregnancy (n = 122,363), and (3) women with Medicaid coverage either before or during pregnancy (n=178,937). Group 3 combines groups 1 and 2, but does not equal the sum of these two groups due to women leaving Medicaid coverage from the pre-pregnancy to prenatal period and missing data. Women with dual coverage (Medicaid plus some other type of insurance) are included in all Medicaid samples. If smoking data are reported for one period, but not another period, the data are included when available.

Measures

For each of our Medicaid sub-groups, we measure the prevalence of smoking at different times during their pregnancy: (1) before pregnancy, (2) during pregnancy, and (3) after delivery. The PRAMS survey asks, "Have you smoked at least 100 cigarettes in the past two years?" For those who answer "yes," three more questions are asked: (1) In the 3 months before you got pregnant, how many cigarettes or packs of cigarettes did you smoke on an average day, (2) In the last 3 months of your pregnancy, how many cigarettes or packs of cigarettes did you smoke on an average day, and (3) How many cigarettes or packs of cigarettes do you smoke on an average day now? These three questions were used to derive the following dependent variables: (1) smoked pre-pregnancy, (2) smoked in the last three months of pregnancy [prenatal], and (3) smoked after delivery (measured an average of 4 months after delivery).

Our second set of dependent variables includes the birth outcomes for the groups of Medicaid insured women in our samples. Selected birth certificate data are appended to each PRAMS observation and provide infant birth weight (grams) and gestational age (weeks at birth) based on clinical or obstetrical estimates. Both of these are measured as continuous dependent variables.

Maternal characteristics included in all models are race/ethnicity, age, marital status, education, prior birth and outcome (no prior birth, normal, low birth weight or preterm, unknown), alcohol consumption during pregnancy, experienced physical abuse by partner or spouse (12 months before or during pregnancy), and number of stressful life factors mother experienced during 12 months before delivery. Additional control variables used in the birth outcome models include the intendedness of pregnancy, infant sex, trimester prenatal care initiated (1^{st}, 2^{nd}, 3^{rd} trimester or none), and presence of diabetes (pre-existing or gestational) or hypertension (pre-existing or gestational). Since our analytic sample is comprised of only poor and near-poor women due to their eligibility for Medicaid, we only control for state level real income (base inflation year = 1982–1984) per capita, derived from the Bureau of Economic Analysis.

Other variables included in all models are the 2008 real (adjusted for inflation) state cigarette price (Orzechowski & Walker Consulting Firm, 2011), and an indicator of a state ban on indoor smoking in all restaurants (CDC, n.d.). Since these data are available by quarter, they are merged to PRAMS records by state and quarter.

Statistical Analysis

We use probit regression models and derive marginal effects of the independent variables using STATA version 12.0. The marginal effects measure the expected change in the prevalence of smoking as a function of a change in the coverage of cessation services, while keeping all other covariates constant and using no change in coverage as the reference. All models include year indicators corresponding to the year of conception, prenatal period, or delivery, and state fixed-effects to account for the state specific factors that could affect both policy and behavior (e.g., anti-tobacco sentiment). There is marked state variation in Medicaid cessation coverage (CDC, 2001, 2003, 2004, 2006, 2008, 2009, 2010), as well as price and smoke-free air laws. In the analysis, women in states with no change in Medicaid cessation coverage serve as controls for women in a state in which there was a change (from none to some, or from less to more generous) in Medicaid coverage. Among our Medicaid insured before pregnancy group, almost none were in states that offered NRT, medications, and counseling in 1996, but this percentage grew to 23.6% in 2000 and, by 2008, 51% were in states that provided this most expansive coverage. We applied PRAMS weights in all analyses, which adjust for survey design and non-response. For the birth outcomes analysis, we use Ordinary Least Squares with PRAMS survey weights. Standard errors are clustered at the state level in all models.

Results

The distributions or means for all dependent and independent variables for the three Medicaid groups are shown in Exhibit 1. Overall, approximately one-third of women enrolled in Medicaid before pregnancy smoked pre-pregnancy. Nearly a quarter (20%) of those enrolled in Medicaid just during pregnancy (enrolled because they qualified due to pregnancy) smoked during pregnancy, and 28% smoked after delivery. The characteristics of women in the different Medicaid enrollment groups were similar on many measures; however, the group that was enrolled before pregnancy (Group 1) had higher percentages of mothers < 20 years of age, of non-Hispanic Black race, with less than a high school education, who were unmarried, and who had a prior low birth weight or preterm birth.

Exhibit 1. Weighted Means or Percentages of Characteristics and Birth Outcomes of Sample Population by Medicaid Insurance Status, Before and During Pregnancy

	Group 1: Enrolled in Medicaid Before Pregnancy	Group 2: Entered Medicaid During Pregnancy	Group 3: Enrolled in Medicaid Either Before or During Pregnancy[1]
Sample N	61,977	122,363	178,937
(Weighted N)	(2,268,481)	(4,794,322)	(6,854,132)
Smoking before pregnancy[2]	33.41%	NA	NA
Smoking during pregnancy[3]	NA	20.22%	21.24%
Smoking after delivery[4]	NA	27.59%	28.42%
Real cigarette price in state in $[5] (mean)	4.16	4.04	4.11
Living in a state with Medicaid cessation coverage of NRT, medication and counseling (%)	22.44%	30.08%	29.43%
Living in a state with Medicaid cessation coverage of NRT and medication, but no counseling (%)	48.87%	40.08%	42.14%
Living in a state with 'some' Medicaid cessation coverage[6] (%)	5.43%	5.18%	5.08%
Living in a state with smoking ban in restaurants (%)	16.18%	16.57%	17.94%
State real income per capita in $1000s [7](mean)	37.51	36.77	37.10
Maternal age (yrs) (%)			
< 20	26.11%	17.98%	20.62%
20 to 24	34.36%	40.24%	38.60%
25 to 29	22.19%	23.93%	23.35%
30 to 34	11.17%	11.50%	11.23%
35 to 39	5.06%	5.20%	5.07%
≥40	1.11%	1.15%	1.13%
Maternal race/ethnicity (%)			
Non-Hispanic black	39.79%	22.59%	27.98%
Hispanic	14.71%	21.70%	19.54%
Non-Hispanic other race	5.73%	4.45%	4.70%
Non-Hispanic white	39.77%	51.26%	47.77%

Exhibit 1 (cont.)

	Group 1: Enrolled in Medicaid Before Pregnancy	Group 2: Entered Medicaid During Pregnancy	Group 3: Enrolled in Medicaid Either Before or During Pregnancy[1]
Maternal education (%)			
Less than high school education	40.22%	30.17%	33.34%
High school education	39.33%	42.10%	41.46%
College education	19.06%	26.45%	23.91%
Education unknown	1.39%	1.28%	1.30%
Maternal marital status (%)			
Unmarried	72.15%	59.82%	64.09%
Married	27.61%	39.96%	35.69%
Married unknown	0.24%	0.22%	0.23%
Maternal physical abuse 12 months before or during pregnancy (%)			
No abuse	85.64%	87.50%	86.92%
Suffered abuse	14.36%	12.50%	13.08%
Maternal life stressors experienced 12 months before delivery (%)			
No stressors	16.63%	15.66%	15.73%
1 or 2 stressors	34.90%	35.69%	35.45%
3 to 5 stressors	34.10%	35.25%	35.08%
6 to 13 stressors	13.77%	12.67%	13.08%
Stressors missing	0.60%	0.73%	0.67%
Alcohol use during Pregnancy (%)			
Non user	77.83%	75.31%	76.14%
User	3.57%	3.24%	3.30%
Alcohol use missing	18.59%	21.45%	20.56%
Previous pregnancy outcome (%)			
No prior birth	29.48%	46.31%	41.12%
Prior normal birth	51.02%	39.94%	43.38%
Prior low birth weight or preterm birth	15.59%	10.12%	11.80%
Prior birth outcome unknown	3.91%	3.63%	3.70%
Additional variables for birth outcome equations			
Sample N	57,283	113,464	165,686
(Weighted N)	(2,218,730)	(4,706,191)	(6,719,638)

Exhibit 1 (cont.)

	Group 1: Enrolled in Medicaid Before Pregnancy	Group 2: Entered Medicaid During Pregnancy	Group 3: Enrolled in Medicaid Either Before or During Pregnancy[1]
Infant outcomes			
Birth weight grams (mean)	3200.06	3273.33	3250.97
Gestational age weeks (mean)	38.99	39.21	39.15
Pregnancy intention (%)			
Wanted, but mistimed birth	42.68%	44.34%	44.05%
Unwanted birth	18.70%	13.29%	14.97%
Intentions unknown	3.09%	2.72%	2.81%
Female baby (%)	48.69%	49.05%	48.95%
Trimester prenatal care initiated (%)			
1st trimester prenatal care	69.26%	70.92%	70.52%
2nd trimester prenatal care	21.12%	20.98%	21.10%
3rd trimester prenatal care	3.84%	3.90%	3.88%
No prenatal care	1.63%	0.56%	0.74%
Missing	4.14%	3.64%	3.75%
Pregnancy complications (%)			
Any diabetes	5.85%	5.18%	5.36%
Any hypertension	6.72%	5.89%	6.15%

NOTES: NRT = Nicotine Replacement Therapy

[1] Group 3 does not equal the sum of Groups 1 and 2, because some women enrolled in Medicaid before pregnancy do not remain in Medicaid during their pregnancy or delivery period or because data on smoking is missing during the prenatal or delivery period.

[2] Smoking before pregnancy defined as 'Yes' to "Have you smoked **at least 100 cigarettes** in the past two years?" and reported a positive value for "In the **3 months before** you got pregnant, how many cigarettes or packs of cigarettes did you smoke on an average day?"

[3] Smoking during pregnancy defined from positive value for "In the **last 3 months** of your pregnancy, how many cigarettes or packs of cigarettes did you smoke on an average day?"

[4] Smoking after delivery defined from positive value for "How many cigarettes or packs of cigarettes do you smoke on an average day **now**?" [Survey response averages 4–6 months after delivery.]

[5] Prices are adjusted for inflation to a base year of 2008.

[6] State has some form of coverage, including states with some form of coverage of NRT, medications, and counseling, but not already represented in categories 1 or 2.

[7] Income per capita is available from the Bureau of Economic Analysis adjusted for inflation to a base year of 1983.

The marginal effects of the different types of Medicaid coverage of cessation services on smoking prevalence before pregnancy, during pregnancy, and after delivery are shown in Exhibit 2. The marginal effects show the effect on smoking of having the specific type of coverage relative to the omitted category, which is no coverage. For example, for Group 1 the result in column 1, row 1 of Exhibit 2, the estimated marginal effect is -0.025 ($p<.10$). The interpretation of this is that living in a state with Medicaid cessation coverage of NRT, medication, and counseling is associated with a decrease in the probability of a woman smoking by 2.5 percentage points relative to those who live in states with no coverage. These results also indicate that among women in Group 1, Medicaid coverage for NRT and medications only, with no coverage for

counseling, reduces the probability of their smoking before pregnancy by 1.6 (p<.05) percentage points. Some cessation coverage (NRT, medications, or counseling) also reduces pre-pregnancy smoking by 3 percentage points (p<.05); only 5% of women in the sample were exposed to this cessation coverage (Exhibit 1). There were no significant effects on smoking before pregnancy from higher real cigarette prices or smoking bans.

Exhibit 2. Probability of Smoking Before, During, and After Pregnancy Among Women with Medicaid Insurance Coverage

Dependent Variable:	Smoking Before Pregnancy[1]	Smoking During Pregnancy[2]	Smoking During Pregnancy[2]	Smoking After Delivery[3]	Smoking After Delivery[3]
Group:	Group 1: Enrolled in Medicaid Before Pregnancy (n=61,977)	Group 2: Entered Medicaid During Pregnancy (n=122,363)	Group 3: Enrolled in Medicaid Either Before or During Pregnancy[4] (n=178,937)	Group 2: Entered Medicaid During Pregnancy (n=122,363)	Group 3: Enrolled in Medicaid Either Before or During Pregnancy[4] (n=178,937)
Living in a state with Medicaid cessation coverage of: NRT, medication, and counseling	-0.025*	-0.004	-0.007	0.008	0.005
	(0.014)	(0.009)	(0.010)	(0.009)	(0.008)
Living in a state with Medicaid cessation coverage of: NRT and medication, but no counseling	-0.016**	0.006	0.006	0.003	0.002
	(0.008)	(0.007)	(0.005)	(0.014)	(0.008)
Living in a state with 'some' Medicaid cessation coverage[5]	-0.030**	0.017	0.011	0.016*	0.014
	(0.010)	(0.016)	(0.010)	(0.009)	(0.010)
Real cigarette price in state in $[6]	-0.014	-0.007	-0.011**	-0.010*	-0.011**
	(0.010)	(0.007)	(0.005)	(0.006)	(0.006)
Living in a state with smoking ban in all restaurants	-0.005	-0.008	-0.013*	-0.022**	-0.018**
	(0.009)	(0.006)	(0.008)	(0.009)	(0.007)
State real income per capita in $[7]	-0.005	0.002	0.001	0.005**	0.003*
	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)
Maternal age (yrs)					
< 20	Reference				
20 to 24	0.077**	0.050**	0.052**	0.040**	0.053**
	(0.009)	(0.006)	(0.006)	(0.006)	(0.007)
25 to 29	0.088**	0.065**	0.070**	0.033**	0.049**
	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)
30 to 34	0.083**	0.073**	0.083**	0.031**	0.049**
	(0.013)	(0.009)	(0.008)	(0.011)	(0.010)
35 to 39	0.081**	0.097**	0.099**	0.041**	0.048**
	(0.014)	(0.014)	(0.013)	(0.014)	(0.012)
≥40	0.091**	0.107**	0.114**	0.030	0.056**
	(0.038)	(0.017)	(0.020)	(0.018)	(0.023)

Exhibit 2 (cont.)

Dependent Variable:	Smoking before pregnancy[1]	Smoking during pregnancy[2]	Smoking during pregnancy[2]	Smoking after delivery[3]	Smoking after delivery[3]
Group:	Group 1: Enrolled in Medicaid Before Pregnancy (n=61,977)	Group 2: Entered Medicaid During Pregnancy (n=122,363)	Group 3: Enrolled in Medicaid Either Before or During Pregnancy[4] (n=178,937)	Group 2: Entered Medicaid During Pregnancy (n=122,363)	Group 3: Enrolled in Medicaid Either Before or During Pregnancy[4] (n=178,937)
Maternal race/ethnicity					
Non-Hispanic black	-0.292**	-0.234**	-0.228**	-0.276**	-0.269**
	(0.013)	(0.014)	(0.013)	(0.017)	(0.016)
Hispanic	-0.304**	-0.324**	-0.312**	-0.354**	-0.345**
	(0.021)	(0.022)	(0.024)	(0.020)	(0.022)
Non-Hispanic other race	-0.193**	-0.105**	-0.121**	-0.119**	-0.135**
	(0.023)	(0.013)	(0.015)	(0.016)	(0.018)
Non-Hispanic white	Reference				
Maternal education					
High school education	-0.059**	-0.074**	-0.074**	-0.063**	-0.065**
	(0.007)	(0.008)	(0.006)	(0.008)	(0.006)
College education	-0.148**	-0.159**	-0.157**	-0.149**	-0.155**
	(0.010)	(0.013)	(0.011)	(0.011)	(0.010)
Education unknown	-0.053	-0.070**	-0.058**	-0.063**	-0.053**
	(0.039)	(0.014)	(0.022)	(0.017)	(0.015)
Less than high school	Reference				
Maternal marital status					
Married	-0.118**	-0.075**	-0.079**	-0.096**	-0.099**
	(0.016)	(0.008)	(0.008)	(0.009)	(0.010)
Married unknown	0.013	0.004	0.007	0.051**	0.044*
	(0.028)	(0.030)	(0.026)	(0.025)	(0.023)
Unmarried	Reference				
Maternal physical abuse 12 months before or during pregnancy					
Suffered abuse	0.044**	0.042**	0.037**	0.040**	0.041**
	(0.008)	(0.005)	(0.004)	(0.004)	(0.005)
No abuse	Reference				
Maternal life stressors experienced 12 months before delivery					
Experienced 1 or 2 stressors	0.091**	0.055**	0.060**	0.066**	0.073**
	(0.008)	(0.006)	(0.007)	(0.006)	(0.005)
Experienced 3 to 5 stressors	0.170**	0.111**	0.118**	0.140**	0.146**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.006)
Experienced 6 to 13 stressors	0.265**	0.166**	0.181**	0.211**	0.223**
	(0.011)	(0.008)	(0.009)	(0.009)	(0.008)
Stressors missing	0.103**	0.008	0.031	-0.013	0.014
	(0.051)	(0.047)	(0.025)	(0.039)	(0.015)
No stressors	Reference				

Exhibit 2 (cont.)

Dependent Variable:	Smoking before pregnancy	Smoking during pregnancy	Smoking during pregnancy	Smoking after delivery	Smoking after delivery
Group:	Group 1: Enrolled in Medicaid before pregnancy (n=61,977)	Group 2: Entered Medicaid during pregnancy (n=122,363)	Group 3: Enrolled in Medicaid either before or during pregnancy[4] (n=178,937)	Group 2: Entered Medicaid during pregnancy (n=122,363)	Group 3: Enrolled in Medicaid either before or during pregnancy[4] (n=178,937)
Alcohol use during pregnancy					
Alcohol user	0.145**	0.072**	0.093**	0.057**	0.079**
	(0.018)	(0.010)	(0.010)	(0.009)	(0.008)
Alcohol user missing	-0.024	-0.015	-0.023*	-0.032*	-0.029*
	(0.025)	(0.015)	(0.012)	(0.017)	(0.017)
Non user	Reference				
Previous pregnancy outcome					
Prior normal birth	0.040**	0.034**	0.047**	0.019**	0.033**
	(0.009)	(0.004)	(0.005)	(0.004)	(0.003)
Prior problem birth	0.060**	0.048**	0.065**	0.036**	0.051**
	(0.012)	(0.009)	(0.008)	(0.007)	(0.005)
Prior birth unknown	0.020*	-0.006	0.017**	-0.022**	-0.003
	(0.011)	(0.009)	(0.007)	(0.008)	(0.006)
No prior birth	Reference				

NOTES: NRT = Nicotine Replacement Therapy, Weighted probit models with marginal effects shown, and standard errors clustered by state in parentheses. Models also include current period time indicators and state fixed effects. Samples are restricted to women on Medicaid before pregnancy (Group 1) for column 1, and during pregnancy for columns 2 and 3 (Groups 2 and 3), * indicates P<.10 ** indicates P<.05

[1] Smoking before pregnancy defined as 'Yes' to "Have you smoked **at least 100 cigarettes** in the past two years?" and reported a positive value for "In the **3 months before** you got pregnant, how many cigarettes or packs of cigarettes did you smoke on an average day?"

[2] Smoking during pregnancy defined from positive value for "In the **last 3 months** of your pregnancy, how many cigarettes or packs of cigarettes did you smoke on an average day?"

[3] Smoking after delivery defined from positive value for "How many cigarettes or packs of cigarettes do you smoke on an average day **now**?" [Survey response averages 4–6 months after delivery.

[4] Group 3 does not equal the sum of Groups 1 and 2, because some women enrolled in Medicaid before pregnancy do not remain in Medicaid during their pregnancy or delivery period or because data on smoking is missing during the prenatal or delivery period.

[5] State has some form of coverage, including states with some form of coverage of NRT, medications, and counseling, but not already represented in categories 1 or 2.

[6] Prices are adjusted for inflation to a base year of 2008.

[7] Income per capita is available from the Bureau of Economic Analysis adjusted for inflation to a base year of 1982–1984.

We find no significant effect of Medicaid cessation coverage on the smoking prevalence of women who enter Medicaid during pregnancy (Exhibit 2, Column 2), but do find that smoking during delivery for women enrolled either before or during pregnancy is affected by higher prices (p<.05) and smoke-free air laws (p<.10; Exhibit 2, Column 3). Results on smoking after delivery for women in Groups 2 and 3 are shown in the last two columns of Exhibit 2. Here, the only effect related to cessation coverage is for 'some' coverage and only at the p <.10 significance level. For both Groups 2 and 3, a $1 increase in cigarette prices is associated with about a 1 percentage point lower prevalence of smoking after delivery. State smoking bans are also

significantly associated with lower smoking (from 1.8 to 2.2 percentage points) for these groups after delivery.

Birth Outcomes

Exhibit 3 shows the effects of Medicaid cessation coverage on birth outcomes for Groups 1–3. The results shown are birth weight in grams and gestational age in weeks for singleton infants

Exhibit 3. Birth Outcomes Among Singleton Births by Timing of Medicaid Insurance

	Birth weight in grams			Gestational age weeks		
	Group 1: Enrolled in Medicaid before pregnancy (n=57,283)	Group 2: Entered Medicaid during pregnancy (n=113,464)	Group 3: Enrolled in Medicaid either before or during pregnancy[1] (n=165,686)	Group 1: Enrolled in Medicaid before pregnancy (n=52,372)	Group 2: Entered Medicaid during pregnancy (n=104,211)	Group 3: Enrolled in Medicaid either before or during pregnancy[1] (n=151,938)
Living in a state with Medicaid cessation coverage of: NRT, medication and counseling	10.177	16.198	12.357*	0.018	0.086**	0.063**
	(11.739)	(12.958)	(7.507)	(0.050)	(0.042)	(0.028)
Living in a state with Medicaid cessation coverage of: NRT and medication but no counseling	24.325	19.171	22.672	0.123	0.036	0.057*
	(24.638)	(13.029)	(14.091)	(0.076)	(0.039)	(0.032)
Living in a state with 'some' Medicaid cessation coverage[2]	9.602	9.341	11.929	0.096	0.087**	0.090**
	(18.403)	(6.550)	(7.680)	(0.074)	(0.036)	(0.037)
Real cigarette price in state in $[3]	40.662*	13.320	20.255*	-0.060	0.100**	0.086**
	(22.700)	(9.794)	(10.708)	(0.117)	(0.033)	(0.032)
Living in a state with smoking ban in all restaurants	14.757	7.663	10.995	0.090*	0.020	0.031
	(11.385)	(10.083)	(8.420)	(0.049)	(0.037)	(0.031)

NOTES: NRT = Nicotine Replacement Therapy. Weighted Ordinary Least Squares models. Coefficients shown with standard errors, clustered by state, in parentheses. Models also include all variables shown in Exhibit 1, including the pregnancy related variables, current time indicators, and state fixed effects. * indicates P<.10 ** indicates P<.05

[1] Group 3 does not equal the sum of Groups 1 and 2, because some women enrolled in Medicaid before pregnancy do not remain in Medicaid during their pregnancy or delivery period or because data on smoking is missing during the prenatal or delivery period.

[2] State has some form of coverage, including states with some form of coverage of NRT, medications, and counseling, but not already represented in categories 1 or 2.

[3] Prices are adjusted for inflation to a base year of 2008.

born to Medicaid insured women. Only comprehensive cessation coverage (NRT, medications, and counseling) is associated with birth weight ($p<.10$), and this result appears only for the combined group of women who enrolled either before or during pregnancy (Group 3). The marginal effect here indicates an increase of 12 grams of birth weight for infants born in states with these coverage policies.

We also see effects of all three cessation coverage categories on increased gestational age for infants of women on Medicaid during pregnancy (Group 3, $p<.10$), and for two of the cessation coverage groups for women entering Medicaid during pregnancy (Group 2, $p<.05$). Again, the effects are small, with cessation coverage associated with an average increase in gestation of less than one day.

Discussion

Our key question is whether Medicaid cessation coverage reduces smoking among women insured by Medicaid before or during pregnancy. We find evidence that coverage of NRT or other medications reduces smoking by 1.6 percentage points among women insured by Medicaid before pregnancy. While the marginal effect of greater coverage, coverage of medications plus individual or group counseling, was larger, equal to 2.5 percentage points, this finding reached statistical significance at only the 10 percent level. Based on our sample of women covered by Medicaid before pregnancy, the first effect implies about a 5 percent rate reduction of smoking, from 33.0% to 31.4%, and if that reduction is applied to the total number of pre-pregnancy smokers in our sample in 2008, approximately 1,000 pre-pregnancy smokers would have quit smoking before pregnancy.

We also ask whether the effects of coverage varied for women insured by Medicaid at different points in pregnancy. As noted, our key finding is for those insured by Medicaid before pregnancy. That we did not find an effect of Medicaid cessation coverage on smoking prevalence during pregnancy could reflect several factors. Women whose pregnancy is covered by Medicaid typically enroll between 5 to 7 months before delivery with 13% enrolling in their last trimester (Thorpe & Galactionova, 2010). Late entry into prenatal care may not allow enough time to receive cessation services. In addition, pregnant smokers, or their providers, may lack knowledge of Medicaid cessation coverage (McMenamin, Halpin, & Bellows, 2006). Finally, counseling is recommended as the first treatment option during pregnancy, and only if women are unable to quit is NRT recommended. Therefore, it is possible that few pregnant smokers are eligible to receive NRT cessation services. We were limited in evaluating the expansion of cessation coverage, because we did not have information on whether women used their covered benefits.

Our study is also limited in that smoking status was not biochemically validated. As Dietz et al. (2011) report, current smoking is not disclosed by 23% of pregnant smokers and 9% of non-pregnant smokers based on serum cotinine concentration levels. Assessing coverage

of cessation services on birth outcomes avoids this potential measurement error, as smoking prevalence is not included in these models. We did find small increases in birth weight for women in states where Medicaid covered only one type of cessation service compared to women living in states with no coverage for cessation services. The increase in birth weight may be explained by women reducing the amount of smoking during pregnancy leading to an improvement in birth weight (England et al., 2001). We also do not know the month of policy implementation and, hence, may have some measurement bias in the exact timing of policy changes.

A key strength of this study is that we assess the effects of changes in state Medicaid coverage of cessation services while controlling for other prevailing state tobacco control policies (i.e., cigarette taxes and smoke-free air laws). We also use pooled cross-sectional data over several time periods so as to measure the effects of actual changes in state policies over time. A recent study of all pregnant women in Massachusetts used only cross-sectional data and found partial indoor smoking ordinances (but not 100% ordinances) was associated with lower prenatal smoking (Nguyen, Wright, Sorensen, & Subramanian, 2012). While our results cannot be generalized beyond the 34 U.S. study states and New York City, the data are from geographically dispersed areas that exhibit wide variation in Medicaid coverage.

Historically, the ability of any state's Medicaid program to reduce smoking among pregnant women has been limited by program standards which make the majority of women eligible *only* if pregnant, and ends their eligibility 60 days postpartum. Moreover, those who enter Medicaid due to their pregnancy are a large portion of all Medicaid paid deliveries (Thorpe & Galactionova, 2010). Under the ACA, Medicaid eligibility will be extended to all those under 133% of the Federal Poverty Level (138% with income disregard) regardless of pregnancy status, but since the July 2012 Supreme Court decision, only in states which choose to participate. A recent ruling from HHS indicates that states will not receive federal funding for partial Medicaid expansions, but that subsidies will be provided for the purchase of insurance for those between 100% and 400% of the FPL (CMS, 2012). As noted earlier, only 24 states and DC are currently planning to participate in the Medicaid expansion (KCMU, 2013).

The essential benefit package provisions of ACA will require coverage of certain preventive services recommended by the U.S. Preventive Services Task Force (USPSTF). The USPSTF recommends as an "A" grade clinical preventive service that clinicians ask all adults about tobacco use and provide tobacco cessation interventions and, for pregnant women, provide augmented, pregnancy tailored counseling to those who smoke. The ACA provides that USPSTF "A" or "B" graded services be covered without cost sharing for those in Medicare, in newly qualified private health insurance plans, newly eligible Medicaid enrollees, and encourages coverage without cost-sharing for those currently Medicaid eligible by increasing the federal match for these services by one percentage point. Yet, gaps in smoking cessation coverage will continue if eligible women live in states that do not choose to expand Medicaid, do

not enroll in public insurance when eligible, buy policies that do not have as extensive benefits as Medicaid, or they are ineligible for coverage under the ACA (e.g., undocumented immigrants).

It is important for states to monitor access to cessation services for low-income women and maintain a broad set of tobacco control policies. Our results indicate that Medicaid coverage of cessation services before pregnancy can lead to modest reductions in smoking, and that tobacco control policies, such as higher taxes, measured here through higher prices, can also be effective in reducing smoking. The key groups that will benefit from expanded Medicaid coverage are those low-income women who are uninsured before or during pregnancy, as studies indicate that free or low-cost cessation services tend to be utilized by uninsured smokers. In one study of free telephone cessation services in 10 states from 2006–2008, pregnant smokers who utilized these cessation services were younger, less educated, and more likely to be uninsured compared to all pregnant smokers (Bombard et al., 2012). In a study of the general population, giving free NRT led to increased calls to telephone quitlines and increased quit rates among those individuals who received the NRT (Bauer, Carlin-Menter, Celestino, Hyland, & Cummings, 2006). While states have now increased Medicaid coverage of cessation services during pregnancy (as of October 2010; McMenamin, Halpin, & Ganiats, 2012), they should review their coverage of cessation services for all Medicaid insured, as well as their combined set of tobacco control policies, in order to achieve the maximum effects possible for reaching smokers before they become pregnant.

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