Impact of State Cigarette Taxes on Disparities in Maternal Smoking During Pregnancy

Summer Sherburne Hawkins, PhD, MS, and Christopher F. Baum, PhD

Objectives. We evaluated the impact of state tobacco control policies on disparities in maternal smoking during pregnancy.

Methods. We analyzed 2000–2010 National Vital Statistics System natality files with 17 699 534 births from 28 states and the District of Columbia that used the 1989 revision of the birth certificate. We conducted differences-in-differences regression models to assess whether changes in cigarette taxes and smoke-free legislation were associated with changes in maternal smoking during pregnancy and number of cigarettes smoked. To evaluate disparities, we included interaction terms between maternal race/ethnicity, education, and cigarette taxes.

Results. Although maternal smoking decreased from 11.6% to 8.9%, White and Black women without a high school degree had some of the highest rates of smoking (39.7% and 16.4%, respectively). These same women were the most responsive to cigarette tax increases, but not to smoke-free legislation. For every $1.00 cigarette tax increase, low-educated White and Black mothers decreased smoking by nearly 2 percentage points and smoked between 14 and 22 fewer cigarettes per month.

Conclusions. State cigarette taxes may be an effective population-level intervention to decrease racial/ethnic and socioeconomic disparities in maternal smoking during pregnancy. (*Am J Public Health.* 2014;104:1464–1470. doi:10.2105/AJPH.2014.301955)

A substantial literature has demonstrated the success of cigarette taxes on decreasing adult smoking.[1–3] State taxes in 2013 ranged from $0.17 in Missouri to $4.35 in New York,[4] and 2010 smoking levels in women were at 17%.[5] Low-income adults, a group with the highest levels of smoking,[5] have been shown to be more sensitive to tax increases.[2,6] Despite racial/ethnic differences in smoking rates,[5] less is known about whether responsiveness to taxes also varies.[7] Over the past decade, many US states have enacted smoke-free legislation in the workplace, restaurants, or both in addition to increasing cigarette taxes. Although the aim of smoke-free policies is to protect nonsmokers from secondhand smoke, for which they have been very effective,[8,9] the evidence for their impact on smoking rates is limited.[1,9,10]

Despite these achievements, a population that has received little attention is pregnant women. The detrimental effects of smoking on maternal and fetal health[11] and other household members through secondhand smoke exposure are well known.[12] Although pregnancy is often a time of positive behavioral change, as of 2008, 10% to 15% of women smoked during pregnancy.[13–15] However, these overall estimates masked racial/ethnic and socioeconomic gradients, such that 16% of White, 9% to 10% of Black, and 2% to 4% of Hispanic mothers smoked during pregnancy,[14,15] and women with 12 or less years of education were more than 3 times (19.4%–22.3%) as likely to smoke during pregnancy as women with more than 12 years of education (6.5%).[15]

Previous studies using data from the 1990s have found that pregnant women are responsive to cigarette tax increases.[16–19] Ringel and Evans[16] used population-level data from 1989 through 1995 and found that every $1.00 increase in cigarette taxes decreased smoking by 6.6 percentage points but had no effect on the number of cigarettes smoked daily. Specifically, they found that women who were White, older, and higher educated were the most responsive to tax changes.[16] However, smoking patterns, social norms, and the politics related to tobacco control have changed over the past 20 years. A more recent study by Adams et al.[20] used state-representative data from 2000 through 2005 to assess both tax changes and smoke-free policies on quitting during pregnancy. They found that a $1.00 cigarette tax increase was associated with a 4.8 percentage point increase in quitting smoking, and a full smoking ban at private worksites increased quit rates by 5.1 percentage points.[20] However, they were unable to examine racial/ethnic or socioeconomic differences because of small sample sizes.

A substantial gap in the literature remains, specifically, the effect of recent tobacco control policies on smoking levels among those mothers at the highest risk for smoking. We were able to use population-level data to exploit the natural experiment created through cigarette tax increases and the enactment of smoke-free legislation across and within US states over the past decade. Our first aim was to examine disparities in maternal smoking during pregnancy across and within racial/ethnic groups and, second, to evaluate the impact of state tobacco control policies on disparities in maternal smoking.

METHODS

We obtained the natality Public Use Micro-Data Files from 2000 through 2004, downloadable through the National Vital Statistics System, with information on all births registered in the 50 US states, the District of Columbia, and New York City.[21] Although state of residence was publicly available from 2000 through 2004, the natality files no longer included state of residence from 2005 onward. We received approval from the National Association for Public Health Statistics and Information Systems for the microdata with state identifiers from 2005 through 2010.[22]

The 1989 revision of the US Standard Certificate of Live Birth contains a Parent Worksheet that asks about tobacco use during pregnancy with a yes–no response and, separately, the

average number of cigarettes per day. This question was modified in the 2003 revision, and the Centers for Disease Control and Prevention[23] stated that the data are not comparable. We included births from all states that used the 1989 revision of the birth certificate from 2000 through at least 2007 but excluded births from any state as of the month and year the state switched to the 2003 revision (Table 1). The following 28 states and the District of Columbia used the 1989 revision through at least 2007: Alaska, Alabama, Arkansas, Arizona, Connecticut, Georgia, Hawaii, Illinois, Louisiana, Massachusetts, Maryland, Maine, Michigan, Minnesota, Missouri, Mississippi, Montana, North Carolina, New Jersey, New Mexico, Nevada, Oklahoma, Oregon, Rhode Island, Utah, Virginia, Wisconsin, and West Virginia.

Among the 18 165 826 births from the 29 states that used the 1989 revision from 2000 through 2010, smoking data were available for 98.6% of births (17 911 015). We further excluded birth certificates if information was missing on mother's country of birth (27 899) or education (191 870). The main analyses included 17 699 534 births, and 99.7% of those had information on the number of cigarettes smoked (17 644 561).

TABLE 1—Maternal Smoking During Pregnancy and Tobacco Control Policies by State: National Vital Statistics System Natality Files, United States, 2000–2010

State	No.	%	Mean % Smoked	Dec. 2010 Cigarette Tax	2000–2010 Tax Change	100% Smoke-Free Workplaces	100% Smoke-Free Restaurants
AL	668 024	3.8	11.8	$0.43	$0.26		
AK	111 390	0.6	16.3	$2.00	$1.00		
AZ	1 001 600	5.7	5.6	$2.00	$1.42	May 1, 2007	May 1, 2007
AR	411 295	2.3	16.3	$1.15	$0.835		
CT	444 973	2.5	6.1	$3.00	$2.50		Oct. 1, 2003
DC[a]	68 070	0.4	3.6	$2.50	$1.85	April 3, 2006	January 1, 2007
GA[b]	1 013 404	5.7	7.9	$0.37	$0.25		
HI	198 049	1.1	6.0	$3.00	$2.00	November 16, 2006	November 16, 2006
IL[c]	1 767 017	10.0	9.3	$0.98	$0.40	January 1, 2008	January 1, 2008
LA	703 120	4.0	10.1	$0.36	$0.16	January 1, 2007	January 1, 2007
ME	148 003	0.8	16.6	$2.00	$1.26	September 12, 2009	January 1, 2004
MD[c]	735 354	4.2	7.5	$2.00	$1.64	February 1, 2008	Feb. 1, 2008
MA	851 053	4.8	7.8	$2.51	$1.75	July 5, 2004	July 5, 2004
MI[a]	967 460	5.5	14.7	$2.00	$1.25	May 1, 2010	May 1, 2010
MN	724 193	4.1	10.1	$1.49	$1.005	October 1, 2007	October 1, 2007
MS	462 788	2.6	12.3	$0.68	$0.50		
MO[c]	761 106	4.3	18.2	$0.17	$0.00		
MT[a]	90 782	0.5	18.3	$1.70	$1.52	October 1, 2005	October 1, 2005
NV[c]	319 510	1.8	8.3	$0.80	$0.45	December 8, 2006	December 8, 2006
NJ	1 210 923	6.8	7.5	$2.70	$1.90	April 15, 2006	April 15, 2006
NM[a]	215 316	1.2	8.8	$1.66	$1.45		June 15, 2007
NC	1 314 187	7.4	12.0	$0.45	$0.40		January 2, 2010
OK[c]	469 046	2.7	16.6	$1.03	$0.80		
OR[a]	359 163	2.0	12.3	$1.18	$0.50	January 1, 2009	January 1, 2009
RI	128 086	0.7	11.3	$3.46	$2.75	March 1, 2005	March 1, 2005
UT[b]	451 036	2.6	6.4	$1.70	$1.185	May 1, 2006	January 1, 1995
VA	1 113 851	6.3	6.9	$0.30	$0.275		
WV	223 140	1.3	26.6	$0.55	$0.38		
WI	767 595	4.3	14.7	$2.52	$1.93	July 5, 2010	July 5, 2010

Note. The total sample size was 17 699 534.
[a]2000–2008.
[b]2000–2007.
[c]2000–2009.

Birth Certificate Variables

On the basis of the self-report smoking question described previously, we dichotomized maternal smoking during pregnancy (yes–no) and recorded the number of cigarettes smoked daily (0–≥ 40).

The birth certificate collects information on mother's race, Hispanic origin, highest level of education, age, and marital status at the time of birth as well as mother's country of birth, number of live births, month prenatal care was initiated, and plurality of birth. We used imputed values when data were missing for maternal race, age, marital status, number of live births, and plurality, which were provided in the data sets.[22] We combined race and Hispanic origin to indicate maternal race/ethnicity (White, Black, Hispanic, Asian/Pacific Islander, American Indian/Alaska Native [AI/AN]).

State Tobacco Control Policies

We obtained the cigarette excise tax for each state from the *Tax Burden on Tobacco*[24] and translated it into real December 2010 dollars using the Consumer Price Index.[25] On the basis of Ringel and Evans's[16] methods, for each baby we determined the cigarette tax (coded in dollars) in that state 9 months before the month of birth as an approximation for the month of conception.

From the American Nonsmokers' Rights Foundation,[26] we obtained the month and year in which 100% smoke-free legislation for workplaces and restaurants came into effect for each state. On the basis of the amount of overlap in both types of legislation (Table 1), we used 100% smoke-free restaurants as a proxy for the smoke-free policies in that state. For each baby, we determined whether that state had smoke-free legislation (yes–no) 9 months before the month of birth.

Statistical Analysis

We first examined the characteristics of women who reported smoking during pregnancy to inform our policy evaluation. We conducted adjusted logistic regression models

to examine predictors of maternal smoking during pregnancy using the sociodemographic and birth-related variables available on the birth certificate. Because there are known gradients in smoking during pregnancy,[14,15] we subsequently stratified the analysis by maternal race/ethnicity. We included state and year fixed effects in all regression equations. State fixed effects control for time-invariant state factors, such as social norms, and year fixed effects control for the overall decreasing trend in smoking[5,15] as well as macroeconomic factors.

We then used differences-in-differences models, a causal inference technique, to evaluate the impact of cigarette taxes and smoke-free legislation on disparities in maternal smoking during pregnancy and, separately, the number of cigarettes smoked. We first conducted a probit regression model to assess whether changes in state tobacco control policies were associated with changes in smoking during pregnancy as a dichotomous outcome. We initially ran stratified models for each racial/ethnic group to identify differences in policy effects, control variables, and state and year trends in smoking. We then constructed a combined model to reflect these differences across groups and allow us to directly compare estimates. This final model included an interaction between maternal race/ethnicity, education, and cigarette taxes and adjustment for the following covariates: 100% smoke-free restaurants, marital status, country of birth, plurality, number of live births, and prenatal care. We also found that the maternal age gradient for smoking during pregnancy varied across racial/ethnic groups and differences in trends across states and years, so we included an additional interaction between maternal race/ethnicity and age, state, and year. Because probit coefficients are not directly interpretable, we calculated average marginal effects to determine the change in the probability of smoking with a $1.00 tax increase and the implementation of smoke-free legislation overall as well as according to maternal race/ethnicity and education.

Using the specifications from our final model of the dichotomous smoking outcome, we then conducted a negative binomial regression model to examine the impact of these same policy changes on changes in the average number of cigarettes smoked daily. Although this model included all births, we calculated average marginal effects for mothers who reported smoking 1 or more cigarettes daily. All analyses were conducted using Stata statistical software, version 12.1SE (StataCorp, College Station, TX), with cluster robust standard errors and clustering by state.

RESULTS

Although the overall prevalence of maternal smoking during pregnancy decreased from 11.6% in 2000 to 8.9% in 2010 (among the 17 states with data for all years), over this time period the mean proportion of mothers who reported smoking varied widely across states, ranging from 3.6% in the District of Columbia to 26.6% in West Virginia (Table 1). Concurrently, state tobacco control policies strengthened. Over these 11 years, mean cigarette taxes increased from $0.45 to $1.54, but as of December 2010 varied from $0.17 in Missouri to $3.46 in Rhode Island. By the end of 2010, 17 of 29 states had 100% smoke-free workplaces and 20 of 29 had 100% smoke-free restaurants, with all but 1 of these policies coming into effect from 2003 onward.

Mothers with the highest prevalence of smoking during pregnancy were White or AI/AN, had 0 to 11 years of education, were US-born, were aged 24 years or younger, were not married, and did not have any prenatal care (Table 2). One of the strongest gradients was maternal education, such that 1.5% of mothers with 16 or more years of education reported smoking during pregnancy compared with 19.4% of mothers with 0 to 11 years. However, when analyses were stratified by maternal race/ethnicity, additional differences were evident (Table A, available as a supplement to the online version of this article at http://www.ajph.org). Educational gradients were even more pronounced among White mothers, with 1.7% of college-educated mothers reporting smoking during pregnancy compared with 39.7% of mothers with less than a high school degree. Differences in maternal age gradients across racial/ethnic groups became evident in adjusted models. White mothers who were aged 30 years or older were less likely to smoke during pregnancy than those aged 25 to 29 years, whereas older Black, Hispanic, and AI/AN mothers were more likely to smoke than their counterparts aged 25 to 29 years.

We found that for every $1.00 increase in cigarette taxes, maternal smoking during pregnancy decreased by 0.50 percentage points overall ($P = .01$), suggesting a 4.8% decrease in the mean smoking rate (Table 3). However, when we examined these differences by maternal race/ethnicity and education, we found that taxes only decreased smoking among White and Black mothers as well as mothers with 15 years of education or less. A similar pattern of results was evident for the number of cigarettes smoked daily (among smokers). Every $1.00 increase in cigarette taxes was associated with a reduction of 0.32 cigarettes per day smoked overall ($P = .01$; Table 3), which translates to nearly 10 fewer cigarettes every month. The effect was only seen among White and Black mothers and mothers with less than a high school degree. By contrast, we found no evidence for an association between smoke-free legislation and maternal smoking rates or the number of cigarettes smoked (both Ps $> .7$; Table 3).

Because low-educated White and Black mothers had some of the highest levels of maternal smoking (Table A), we tested the effects of cigarette taxes on these gradients by calculating average marginal effects according to race/ethnicity and education combined. Table 4 demonstrates that cigarette taxes had the largest effect among White and Black mothers with less than a high school degree for both maternal smoking rates and the number of cigarettes smoked daily. For White mothers this translated into a 1.98 percentage point decrease in maternal smoking and 22 fewer cigarettes smoked per month (0.74 fewer daily; both Ps $\leq .01$). Among Black mothers, the impact of taxes on smoking rates was seen across all levels of education, albeit with a decreasing effect. Across the 4 education groups, the impact of taxes on smoking rates decreased from 1.81 to 0.22 percentage points (all Ps $\leq .02$). Similar results were seen for the number of cigarettes smoked daily, with the largest effect among mothers with less than a high school degree and translating to nearly 14 fewer cigarettes smoked per month (0.46 fewer daily; $P = .006$). We tested whether taxes had differential effects on the smoking rate between White and Black mothers across education and found no differences for the 2 lowest education groups, but a significant difference for the 2 highest groups (results not shown).

TABLE 2—Maternal Sociodemographic Characteristics and Predictors of Smoking During Pregnancy: National Vital Statistics System Natality Files, United States, 2000–2010

Characteristic	No. (%)	Mean % Smoked	Adjusted OR[a] (95% CI)
Race/ethnicity			
White	10 757 562 (60.8)	13.4	1.00 (Ref)
Black	3 124 171 (17.7)	8.5	0.23 (0.20, 0.27)
Hispanic	2 691 848 (15.2)	2.9	0.17 (0.13, 0.23)
Asian/Pacific Islander	851 745 (4.8)	2.4	0.47 (0.40, 0.55)
American Indian/Alaska Native	274 208 (1.6)	17.7	0.55 (0.32, 0.93)
Education, y			
0–11	3 319 524 (18.8)	19.4	1.00 (Ref)
12	5 372 363 (30.4)	15.0	0.49 (0.47, 0.51)
13–15	3 944 968 (22.3)	8.4	0.25 (0.24, 0.27)
≥ 16	5 062 679 (28.6)	1.5	0.05 (0.04, 0.06)
Country of birth			
US-born	14 312 902 (80.9)	12.6	1.00 (Ref)
Foreign-born	3 386 632 (19.1)	1.6	0.17 (0.16, 0.19)
Age, y			
< 19	1 846 652 (10.4)	14.7	0.57 (0.57, 0.57)
20–24	4 434 548 (25.1)	15.6	0.99 (0.98, 0.99)
25–29	4 837 069 (27.3)	9.7	1.00 (Ref)
30–34	4 128 070 (23.3)	6.3	0.91 (0.91, 0.92)
≥ 35	2 453 195 (13.9)	6.7	0.98 (0.97, 0.99)
Marital status			
Married	11 208 023 (63.3)	6.2	1.00 (Ref)
Not married	6 491 511 (36.7)	17.8	2.83 (2.60, 3.08)
Plurality			
Singleton	17 085 627 (96.5)	10.6	1.00 (Ref)
Multiple birth	613 907 (3.5)	8.0	0.80 (0.78, 0.81)
No. of live births			
1	7 093 377 (40.1)	8.9	1.00 (Ref)
2	5 735 797 (32.4)	10.0	1.34 (1.29, 1.39)
≥ 3	4 870 360 (27.5)	13.5	1.76 (1.67, 1.84)
Prenatal care initiation			
First trimester	14 522 460 (82.1)	9.4	1.00 (Ref)
Second trimester	2 258 936 (12.8)	15.3	1.33 (1.29, 1.38)
Third trimester	442 524 (2.5)	16.8	1.49 (1.37, 1.62)
None	176 681 (1.0)	24.2	2.25 (2.02, 2.50)
Unknown	298 933 (1.7)	11.5	1.15 (0.99, 1.33)

Note. CI = confidence interval; OR = odds ratio. The total sample size was 17 699 534.
[a]CI based on cluster robust standard errors; year and state fixed effects not shown.

Although we found no associations between taxes and maternal smoking during pregnancy for Hispanic or Asian/Pacific Islander mothers, some differences were evident in the number of cigarettes smoked (among smokers; Table 4). Among Hispanic mothers with less than a high school degree, for every $1.00 increase in cigarette taxes, mothers smoked 2.4 more cigarettes per month (0.08 more daily; $P = .009$). A similar increase in smoking was seen for Asian mothers with a college degree or more. For every $1.00 increase in taxes, these mothers smoked 0.3 more cigarettes per month (0.01 daily; $P = .01$). Although these findings are counter to the overall pattern of results, the effect sizes are quite small. For AI/AN mothers, we found no effect of cigarette taxes on the number of cigarettes smoked daily.

DISCUSSION

Although decreasing trends in maternal smoking during pregnancy may appear as a public health success, racial/ethnic and educational disparities continue to persist. We have shown that White and Black women with less than a high school degree have some of the highest rates of maternal smoking during pregnancy at 40% and 16%, respectively. We found that these same women were the most responsive to cigarette tax increases, but not to smoke-free legislation. For every $1.00 cigarette tax increase, low-educated White and Black mothers decreased smoking by nearly 2 percentage points, and the smokers in these groups smoked between 14 and 22 fewer cigarettes per month. Our findings suggest that state cigarette taxes may be an effective population-level intervention to decrease certain racial/ethnic and socioeconomic disparities in maternal smoking during pregnancy.

The first decade of the 21st century has been an active time of policy change with cigarette tax increases and the enactment of smoke-free legislation in workplaces and restaurants. Despite the known consequences of smoking on fetal health and development, particularly the risk of low birth weight,[11] only a few studies have considered the effects of state tobacco control policies on pregnant women, and most used data from an earlier time period when smoking patterns and policies were very different.[16–19] We addressed these gaps by using population-level data to examine the extent to which pregnant women were responsive to recent policy changes and their impact on known disparities in smoking. Consistent with Ringel and Evans,[16] who used the natality files from 1989 through 1995, we also found that cigarette tax increases were associated with decreases in maternal smoking during pregnancy. However, Ringel and Evans reported an overall 6.6 percentage point decrease in smoking associated with a $1.00 tax increase and that women who were White, older, and higher educated were the most responsive.[16] By contrast, we found an overall 0.50 percentage point decrease in smoking, and low-educated White and Black women were the

TABLE 3—Marginal Effects of the Impact of State Tobacco Control Policies on Maternal Smoking During Pregnancy and Number of Cigarettes Smoked Daily (Among Smokers): National Vital Statistics System Natality Files, United States, 2000–2010

Variable	Mean	Marginal Effect of Coefficient[a]	*P*
Maternal smoking yes–no, %			
All births (n = 17 699 534)	10.5		
Cigarette tax, $1.00		–.0050	.01
100% smoke-free restaurants, yes–no		–.0010	.7
Interaction with cigarette tax, $1.00			
Maternal race/ethnicity			
White	13.4	–.0052	.04
Black	8.5	–.0103	< .001
Hispanic	2.9	.0001	.8
Asian/Pacific Islander	2.4	–.0000	> .999
American Indian/Alaska Native	17.7	–.0006	.9
Maternal education, y			
0–11	19.4	–.0102	.001
12	15.0	–.0068	.04
13–15	8.4	–.0041	.05
≥ 16	1.5	–.0003	.7
Cigarettes smoked daily, no.			
Births to smokers only (n = 1 800 736)	9.4		
Cigarette tax, $1.00		–.32	.01
100% smoke-free restaurants, yes–no		–.05	.8
Interaction with cigarette tax, $1.00			
Maternal race/ethnicity			
White	10.0	–.35	.02
Black	6.9	–.27	.01
Hispanic	6.9	.02	.5
Asian/Pacific Islander	7.0	–.02	.6
American Indian/Alaska Native	8.0	–.14	.2
Maternal education, y			
0–11	9.6	–.62	.007
12	9.4	–.21	.06
13–15	9.0	–.07	.2
≥ 16	8.3	–.01	.7

[a]Model includes interaction between maternal race/ethnicity, education, and cigarette tax; adjustment for the following covariates: 100% smoke-free restaurants, marital status, country of birth, plurality, number of live births, and prenatal care; interaction between maternal race/ethnicity and the following covariates: maternal age, state, and year.

most responsive. In the early 1990s, the overall prevalence of prenatal smoking was 16.5%[16] compared with 10.5% in our study. The success of tobacco control policies and changes in social norms and population dynamics of smokers, potentially related to the hardening of remaining smokers,[27] may explain why current smokers have different sociodemographic characteristics than those in past studies. Our results show that even though taxes had a smaller effect on smoking rates than previous studies, pregnant women with the highest levels of smoking were the most responsive to tax changes.

We found an additional effect of cigarette taxes on the number of cigarettes smoked daily, such that for every $1.00 tax increase, White and Black mothers with less than a high school degree smoked between 14 and 22 fewer cigarettes per month. By contrast, Ringel and Evans[16] found no effect of tax changes on the number of cigarettes smoked, and the positive coefficient suggested an increase in the number of cigarettes smoked. They proposed that if tax changes influenced light smokers to quit, it would decrease overall smoking rates but could increase the new average number of cigarettes smoked.[16] This hypothesis needs to be explored for our results that low-educated Hispanic mothers (0.08 per day) and high-educated Asian/Pacific Islander mothers (0.01 per day) slightly increased the number of cigarettes smoked daily. Repeating this analysis using different datasets would help investigate potential reasons for the result.

Smoke-free policies protect nonsmokers from secondhand smoke, and only in the past decade have they become widely enacted throughout the country.[26] Despite the success of smoke-free policies on reducing secondhand smoke exposure and acute coronary events,[8,9] they do not appear to have had a similar effect on smoking rates.[9,10] However, some evidence is suggestive that they may reduce the number of cigarettes smoked.[9,10] Adams et al.[20] assessed both tax changes and smoke-free policies on quitting smoking during pregnancy, but they did not examine smoking rates. They found an effect for both taxes and full smoking bans at private worksites on quitting smoking during pregnancy, but because of small sample sizes were unable to examine specific subgroups at higher risk. Because the natality files do not include information on smoking prepregnancy, we were unable to examine quit rates. Smoke-free policies are enacted at both the local and the state levels, but state was the lowest geographical unit available. We may have been unable to detect an effect if women lived in an area with only local smoke-free legislation. Future studies with more detailed geographical data could help tease apart the relative importance of local- and state-level policies.

Although we used population-level data from 28 states and the District of Columbia, representing all regions of the United States, the results may not be fully generalizable to the states not included. However, because of changes in the wording of the tobacco use question on the 2003 revision of the birth certificate,[23] it was not possible to include the data from the remaining states. Our outcome measures of prenatal smoking were based on self-report. Among pregnant women, the prevalence of

TABLE 4—Marginal Effects of the Impact of State Cigarette Taxes on Maternal Smoking During Pregnancy and Number of Cigarettes Smoked Daily (Smokers Only) by Maternal Race/Ethnicity and Education: National Vital Statistics System Natality Files, United States, 2000–2010

	Maternal Smoking During Pregnancy (All Births)			No. of Cigarettes Smoked Daily (Births to Smokers Only)		
Maternal Race/Ethnicity, Education	Mean % Smoked	Marginal Effect of Coefficient for $1.00 Tax Increase[a]	*P*	Mean No. of Cigarettes	Marginal Effect of Coefficient for $1.00 Tax Increase[a]	*P*
White						
0–11 y	39.7	−0.0198	.004	10.5	−0.74	.01
12 y	21.1	−0.0077	.1	10.0	−0.23	.08
13–15 y	10.5	−0.0035	.2	9.5	−0.07	.2
≥ 16 y	1.7	−0.0002	.9	8.5	−0.01	.8
Black						
0–11 y	16.4	−0.0181	< .001	7.1	−0.46	.006
12 y	8.5	−0.0097	.004	6.9	−0.14	.06
13–15 y	4.9	−0.0082	.001	6.7	−0.08	.04
≥ 16 y	1.2	−0.0022	.02	6.6	−0.01	.3
Hispanic						
0–11 y	3.0	0.0022	.2	6.9	0.08	.009
12 y	3.4	−0.0015	.4	7.0	−0.04	.4
13–15 y	2.8	−0.0028	.1	7.1	−0.06	.1
≥ 16 y	0.9	−0.0009	.3	7.0	−0.03	.07
Asian/Pacific Islander						
0–11 y	7.1	0.0035	.4	7.0	0.03	.8
12 y	5.0	−0.0022	.09	7.1	−0.06	.3
13–15 y	2.6	−0.0004	.8	6.8	−0.01	.9
≥ 16 y	0.4	0.0005	.1	6.4	0.01	.01
American Indian/Alaska Native						
0–11 y	25.7	−0.0065	.4	8.1	−0.15	.4
12 y	18.3	0.0034	.5	8.0	−0.19	.2
13–15 y	11.3	−0.0001	> .999	8.1	−0.00	> .999
≥ 16 y	3.6	−0.0018	.5	8.0	−0.02	.8

[a]Model includes interaction between maternal race/ethnicity, education, and cigarette tax; adjustment for the following covariates: 100% smoke-free restaurants, marital status, country of birth, plurality, number of live births, and prenatal care; interaction between maternal race/ethnicity and the following covariates: maternal age, state, and year.

smoking by self-report has been shown to be lower than biochemical validation, and nondisclosure is higher among pregnant than nonpregnant active smokers.[28] A comparison of self-report between the birth certificate and the Pregnancy Risk Assessment Monitoring System, a representative survey of mothers about 4 months postpartum, also indicated that mothers underreport smoking on the birth certificate.[29] In 2004, prenatal smoking was reported as 10.4% on the birth certificate (any smoking), 13.4% in the Pregnancy Risk Assessment Monitoring System (smoking during the last 3 months of pregnancy), and 15.1% using both sources. Allen et al.[29] found that although more underreporting on the birth certificate occurred among older and more educated mothers, both sources nonetheless independently identified the same groups of women as being at the highest risk for smoking. However, even with underreporting among the same groups in our study, these mothers had the lowest rates of smoking and were least responsive to cigarette tax changes.

The *Healthy People 2020* target is to increase abstinence from cigarette smoking among pregnant women to 98.6%.[30] Without recognizing the strong racial/ethnic and socioeconomic disparities in maternal smoking during pregnancy that we have shown, it may be challenging to achieve this target. In addition to current guidelines for smoking cessation during pregnancy,[31,32] we have demonstrated that cigarette taxes may be an effective population-level intervention to reduce smoking among the highest risk mothers. Because there is evidence for a dose–response relationship between the number of cigarettes per day and adverse birth outcomes,[11] these findings have important public health implications. In mid-2013, the gap in cigarette taxes between states with the lowest and the highest rates was $4.18.[4] If states do not increase taxes, a further strategy may be to increase the federal excise tax on cigarettes, such as the $0.50 tax increase suggested by the Congressional Budget Office.[33] Our findings suggest that additional cigarette tax increases would continue to reduce disparities in maternal smoking during pregnancy and have the potential to improve population health. ■

About the Authors

Summer Sherburne Hawkins is with the Graduate School of Social Work, Boston College, Chestnut Hill, MA. Christopher F. Baum is with the Department of Economics, Boston College, and the Deutsches Institut für Wirtschaftforschung, Berlin, Germany.

Correspondence should be sent to Summer Sherburne Hawkins, PhD, MS, Graduate School of Social Work, Boston College, McGuinn Hall, 140 Commonwealth Avenue, Chestnut Hill, MA 02467 (e-mail: summer.hawkins@bc.edu). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints" link.

This article was accepted February 17, 2014.

Contributors

S. S. Hawkins conceptualized and designed the study; participated in data collection, analysis, and interpretation; and drafted the initial article. C. F. Baum participated in data analysis and interpretation and reviewed and revised the article. Both authors approved the final article as submitted. S. S. Hawkins had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Acknowledgments

Research reported in this publication was supported by a Eunice Kennedy Shriver National Institute of Child Health and Human Development Award (R00HD068506 to S. S. H.).

We thank Rachel Boyce, data coordinator at the Harvard Center for Population and Development Studies, for data management and the National Center for Health Statistics for the natality files.

Note. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

Human Participant Protection

The Boston College institutional review board reviewed this study and considered it exempt.

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