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Impact of tobacco control policies on adolescent smoking

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Abstract

Purpose—Our aims were to examine the impact of cigarette taxes and smoke-free legislation on current adolescent smoking and smoking frequency overall as well as test whether there were differential policy effects by age.

Methods—Using data on 717,543 adolescents from 43 states in the 1999–2013 Youth Risk Behavior Surveys, we used difference-in-differences regression models to evaluate the impact of tobacco control policies on current adolescent smoking (yes/no) and, separately, smoking frequency (defined as 0, 1–5, 6–29, 30+ days per month). We tested an interaction between age and cigarette taxes and, separately, smoke-free legislation.

Results—From 1999–2013, adolescent smoking decreased from 35.3% to 13.9% and 41/43 states increased their cigarette tax in real terms by an average of 257%. By the end of the study period, 29/43 states had 100% smoke-free restaurant legislation. Although we found no overall effect of cigarette taxes on current smoking, there was a significant interaction by age. Among 14- and 15-year-olds, every $1.00 cigarette tax increase was associated with a 2.2 and 1.6 percentage point reduction in smoking, respectively. The enactment of 100% smoke-free restaurant legislation was associated with an overall reduction in adolescent smoking by 1.1 percentage points and there were no differences by age. Cigarette taxes and smoke-free legislation were also associated with decreased smoking frequency.

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Conclusions—The youngest adolescents are the most price sensitive and cigarette taxes continue to be a successful approach to reduce adolescent smoking. Smoke-free legislation may also be an effective strategy to reduce smoking among all adolescents.

Keywords

Cigarette smoking; taxes; smoke-free policy; adolescent

Introduction

While overall adolescent cigarette use has been declining over time,[1, 2] one of the strongest determinants of smoking is age.[1–3] By middle school 3% of students report current (past 30-day) smoking, increasing to 9% in high school.[1] Even between 9th and 12th grade, smoking rates nearly double.[3] Since the majority of adult smokers start during adolescence,[2] prevention efforts need to begin before smoking behaviors are established.

For adolescents, the principal aims of tobacco control policies are to reduce the initiation of adolescent smoking, reduce smoking frequency, and encourage quitting.[4] Although there has been a growing body of research demonstrating that higher cigarette taxes are associated with reductions in the prevalence[5–10] and intensity[7, 8] of adolescent smoking,[11] the evidence is less conclusive for smoke-free legislation.[5, 8, 11, 12] Since an earlier age of smoking initiation increases the likelihood of being a regular smoker[13] and greater nicotine addiction,[14] it is critical to identify policies that decrease or delay the uptake of smoking throughout adolescence. Research demonstrating an effect of cigarette prices on the age of smoking initiation has been limited to longitudinal studies that have not included smoke-free legislation.[6, 9] It is, therefore, unclear whether smoke-free policies reduce smoking initiation or have a similar impact across the teenage years.

Over the past decade state tobacco control policies have strengthened considerably. Between 2005 through 2015, cigarette taxes have increased on average from $0.92 to $1.60, the number of states with 100% smoke-free restaurant legislation increased from 10 to 34, workplaces from 9 to 34, and bars from 6 to 28.[15] However, more recently, only a few studies have examined the effects of cigarette taxes[5–9] or smoke-free legislation[5, 8] on adolescent smoking behaviors and there is limited evidence on how the effects of these policies may differ across the adolescent years. Whether and to what extent these policy changes continue to impact adolescent smoking remains unresolved. Identifying the age groups benefiting (or not) from these policies will help inform the next steps for tobacco control prevention.

Changes in tobacco control policies across and within US states has created a natural experiment, which we evaluated using repeated cross-sectional data from a state-representative survey of over 700,000 adolescents. Our aims were to examine the impact of cigarette taxes and smoke-free legislation on current adolescent smoking and smoking frequency overall as well as test whether there were differential policy effects by age.

Methods

Data

The Centers for Disease Control and Prevention (CDC) has conducted the Youth Risk Behavior Survey (YRBS), a survey of the health risk behaviors of 9th through 12th grade students attending public and private schools, biennially since 1991. The YRBS uses a two-stage cluster sampling design to produce state-level representative samples. Students complete a self-administered questionnaire during a regular class period and participation is anonymous and voluntary. The CDC requires a minimum overall response rate of at least 60% for state data to be weighted and included.[3, 16] The annual sample size of the YRBS has increased over time due to the number of participating states and the percentage with weighted data. Additional information on the YRBS methodology is available elsewhere.[3, 16]

We analyzed 8 sweeps of YRBS data for 43 states from 1999 through 2013.[17] We received YRBS data from the CDC for 32 states (Alabama, Alaska, Arizona, Arkansas, Connecticut, Illinois, Iowa, Kansas, Kentucky, Maine, Maryland, Michigan, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, North Dakota, Oklahoma, Rhode Island, South Carolina, South Dakota, Tennessee, Utah, Virginia, West Virginia, Wisconsin, Wyoming) and directly from 11 states (Delaware, Florida, Georgia, Idaho, Indiana, Louisiana, Massachusetts, New York, Ohio, Texas, Vermont). Of the 804,062 adolescents in the YRBS, 717,543 were included in the analyses. Adolescents were excluded if information was missing on cigarette use (39,508), strata (25,983), race (17,367), gender (4,899), or age (2,543), or the student was younger than age 14 years (5,775).

Smoking status

Adolescents were asked, “During the past 30 days, on how many days did you smoke cigarettes?”, with 7 responses ranging from 0 days to all 30 days. We created two variables describing current cigarette smoking. We defined current smoking as a dichotomous measure: no (0 days) versus yes (1–30+ days). We also defined smoking frequency as a categorical variable indicating the number of days/month that adolescents smoked cigarettes: 0, 1–5, 6–29, 30+ days.

Socio-demographic characteristics

Adolescents reported on their age (14, 15, 16, 17, 18 years) and gender (female, male). We combined self-report of ethnicity and race to create a four category variable of race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, non-Hispanic other). No other socio-demographic information on the students or families was collected consistently across states and years.

Tobacco control policies

We linked state tobacco control policies to each adolescent based on the year the survey was completed. The cigarette tax per pack of 20 cigarettes for each state was obtained from the *Tax Burden on Tobacco*[18] and translated into real dollars using the national consumer price

index (1982–1984=100).[19] 100% smoke-free legislation for workplaces and restaurants in each state was obtained from the *American Nonsmokers' Rights Foundation*.[20] As all 24 states with smoke-free workplaces also had smoke-free restaurants, we used smoke-free restaurant legislation as a proxy for state smoke-free policies. Furthermore, adolescents are more likely to be exposed to policies in restaurants than those in workplaces or bars. As the majority of states conduct the surveys in the spring of the cycle year,[3, 16] we averaged the cigarette tax from January–March and adolescents were indicated as living in a state with smoke-free legislation if their state had restaurant legislation by March of the cycle year.

State funding of tobacco control programs and activities varies widely.[21, 22] The CDC's State Tobacco Activities Tracking & Evaluation (STATE) System has recorded the annual amount of appropriations/grants each state receives for tobacco control efforts from state and federal sources, the Robert Wood Johnson Foundation, and the American Legacy Foundation from 1999 through 2011.[15] For 2013, we constructed total funding based on appropriations/grants from state and federal sources only;[21] as in 2011, funding from both foundations ranged from 0.0–2.6% of each state's total amount.[15] To control for state differences, we included an annual per capita measure of the amount of tobacco control funding constructed by dividing the total funds for each state by the US census population estimates for all ages from corresponding years.

The 1992 Synar Amendment mandated that all states prohibit the sale of tobacco to minors by mid-1995.[2] Since laws restricting the sale of tobacco to adolescents age 18 and younger came into effect prior to the YRBS data from 1999, youth access policies were not included.

The IRB at Boston College reviewed this study and considered it exempt.

Statistical analysis

We first examined the characteristics of current smokers and conducted adjusted logistic regression models to assess the associations of current adolescent smoking and socio-demographic characteristics (age, race/ethnicity, and gender). We included state and year fixed effects in all regression analyses to control for time-invariant state factors, such as social norms related to tobacco use, and decreasing trends in adolescent smoking.[2, 23]

We then conducted difference-in-differences models, a causal inference technique from economics,[24] to evaluate the impact of cigarette taxes and smoke-free legislation on current adolescent smoking and, separately, smoking frequency. We first conducted a probit regression model to assess whether changes in state tobacco control policies were associated with changes in current adolescent smoking as a dichotomous outcome (yes/no), controlling for socio-demographic characteristics, tobacco control expenditure, year, and state. State funding for tobacco-related programs and activities was not associated with current smoking (results not shown). Since the prevalence of smoking varies across adolescence[2, 23] and an aim of tobacco control efforts is to prevent smoking initation,[2] we tested an interaction between age and cigarette taxes and, separately, smoke-free legislation. As probit coefficients are not directly interpretable, we calculated average marginal effects to determine the change in the probability of adolescent smoking with a $1.00 cigarette tax increase or the implementation of smoke-free legislation.

We subsequently conducted an ordered probit regression model to assess the impact of changes in state tobacco control policies on smoking frequency, defined as the number of days/month that adolescents smoked (0, 1–5, 6–29, 30+ days). We also tested an interaction between age and each tobacco control policy. To aid interpretability, we calculated average marginal effects for each smoking outcome category. In ordered probit models, the marginal effects of each predictor variable across the different outcome categories sum to zero.

We conducted analyses using Stata statistical software, version 14.0 (StataCorp, College Station, TX), to account for the complex sample design and included weights to provide representative estimates. Survey weights were based on adolescents' gender, race/ethnicity, and school grade to adjust for nonresponse and oversampling of black and Hispanic adolescents.[16]

Results

Although from 1999 through 2013 adolescent smoking decreased from 35.3% to 13.9% (among the 16 states with data for both years), the mean prevalence of current smoking varied across states ranging from 7.5% in Utah to 28.1% in South Dakota (Table 1). Over the study period, 41/43 states increased their cigarette tax in real terms by an average of 257% (range from 28% in Louisiana to 1319% in Kentucky), while Missouri and North Dakota decreased their tax in real terms by 29%. By 2013, the mean cigarette excise tax was $1.44 (range from $0.17 in Missouri to $4.35 in New York) and 29/43 states had 100% smoke-free restaurant legislation.

Current smoking increased by age, with a 2.89 increased odds of smoking at age 18 compared to age 14, and males were 1.12 times more likely to report current smoking than females (Table 2). Non-Hispanic black and Hispanic adolescents and those who reported as non-Hispanic other race/ethnicity were less likely to smoke than non-Hispanic white adolescents. Overall, adolescents were also 72% less likely to smoke in 2013 than in 1999. Comparable differences were seen according to smoking frequency (Table A1). For example, among 14-year-olds, 88.7% smoked 0 days and 2.1% smoked 30+ days, while corresponding rates for 18-year-olds were 72.7% and 10.3%, respectively.

Although we found no overall effect of cigarette taxes on current smoking (p=0.08), tax increases had a larger impact on smoking rates among the youngest adolescents (interaction p=0.009) (Table 3). Every $1.00 increase in cigarette taxes was associated with a 2.2 and 1.6 percentage point decrease in current smoking among 14- and 15-year-olds, respectively. Patterns were consistent when smoking frequency was examined (Table 4). An interaction with age also revealed that higher taxes decreased the number of days/month that the youngest adolescents smoked cigarettes (p=0.02). Among 14-year-olds, every $1.00 increase in cigarette taxes was associated with being 1.9% more likely to smoke 0 days/month and comparatively 0.7% less likely to smoke 1–5 days and 0.6% for 6–29 or 30+ days. Similarly among 15-year-olds, every $1.00 increase in taxes was associated with being 1.3% more likely to smoke 0 days/month and 0.4–0.5% less likely to smoke 1–5, 6–29, and 30+ days. We found no evidence for an effect of taxes on smoking among older adolescents.

The enactment of smoke-free legislation was associated with a 1.1 percentage point decrease in current adolescent smoking overall (Table 3). Smoke-free legislation also decreased smoking frequency (Table 4). The enactment of smoke-free legislation was associated with being 1.2% more likely to smoke 0 days/month and comparatively, 0.3% less likely to smoke 1–5 days, 0.4% for 6–29 days, and 0.5% for 30+ days. There were no differences by age for either measure of smoking (interactions $p>0.05$).

Discussion

During this time of active policy change, we found that cigarette tax increases were associated with reduced current smoking and smoking frequency for the youngest adolescents while the enactment of smoke-free legislation reduced smoking rates overall. Among 14- and 15-year-olds, every $1.00 cigarette tax increase was associated with a 2.2 and 1.6 percentage point reduction in smoking, respectively. The enactment of 100% smoke-free restaurant legislation was associated with an overall reduction in smoking by 1.1 percentage points. In our study, the mean prevalence of smoking in 2013 was 13.0% and increased across age from 6.8% to 20.6% for 14- to 18-year-olds, respectively. According to our estimates, if cigarette taxes increased by $0.94 as proposed in the 2016 federal budget,[25] smoking among 14- and 15-year-olds would decrease, on average, by 13.1% and 7.4%, respectively. In addition, if the remaining states implemented smoke-free legislation, overall smoking would decrease, on average, by 8.5%.

Cigarette taxes are one of the most effective tobacco control policies to reduce smoking rates and have the greatest impact at younger ages.[4, 26, 27] Recent studies have shown that cigarette tax increases were associated with reductions in adolescent cigarette use[5–9] and intensity.[7, 8] We did not find evidence for an effect of cigarette taxes on current smoking overall, but a significant interaction revealed that 14- and 15-year-olds were the most responsive to tax increases. Carpenter and Cook used national YRBS data from 1991–2005, a period in which the mean prevalence of smoking was 29.5%. They found that every $1.00 increase in cigarette taxes was associated with a reduction in overall adolescent smoking by 6 percentage points.[7] They also found that cigarette tax increases reduced frequent smoking, defined as having smoked on at least 20 of the past 30 days. The mean prevalence of smoking has changed substantially over the two study periods, declining to 19.3% in the 1999–2013 period of our sample. Our estimate of the effect of a $1.00 increase in cigarette taxes was 1.6–2.2 percentage points. Likely reasons for the differences in effect sizes are related to the success of tobacco control policies, changes in social norms related to smoking as well as the characteristics of adolescent smokers. Two additional studies found that cigarette prices reduced adolescent smoking prevalence[5, 8] and intensity of smoking (defined as the number of cigarettes smoked monthly).[8] Since the price of cigarettes consists of state and federal excise taxes and the percentage markups by wholesalers and retailers,[28] raising cigarette excise taxes has been suggested as the most effective way for policymakers to increase cigarette prices.[29] Although results from studies using tax versus price are not directly comparable, the messages are similar—adolescents are less likely to smoke when faced with higher cigarette costs.

Despite the call for more research to assess whether policy effects vary by age,[11] an important predictor of adolescent smoking,[1–3] none of the studies to date specifically examined whether tobacco policies varied by age during adolescence. Two longitudinal studies have shown that adolescents were less likely to initiate smoking when faced with higher cigarette prices.[6, 9] We found that despite decreasing trends in smoking overall, the prevalence of current smoking more than doubled from age 14 to 18 years (from 11.3% to 27.3%). Our results showed that the youngest (14- and 15-year-old) adolescents were the most responsive to cigarette tax increases suggesting either a decrease or delay in the uptake of smoking. In contrast, we found no evidence that cigarette tax increases reduced smoking among 16–18-year-olds, who had the highest levels of current smoking and smoking frequency. Considering it is illegal for adolescents below age 18 to purchase cigarettes,[2] further research is needed to understand how policies affect smoking behaviors as adolescents' age into young adulthood. Analyses using future waves of the YRBS will help distinguish whether higher cigarette taxes continue to reduce the uptake of smoking among younger adolescents or faced with higher prices, they are switching to cheaper tobacco products.

While there is limited evidence that smoke-free legislation reduces adult smoking,[12, 30] consistent with two recent studies,[5, 8] we have shown that the enactment of 100% smoke-free restaurant legislation was associated with a reduction in overall adolescent smoking and smoking frequency. Furthermore, we found no differences in the effects of smoke-free legislation by age. Our findings suggest that smoke-free restaurants may limit adolescent opportunities for smoking and, thus, both reduce the use of cigarettes as well as their frequency. The enactment of smoke-free legislation may also indicate a change in the state's social norms around smoking. Although we also controlled for state funding for tobacco programs and state fixed effects controlled for time-invariant characteristics, there may be other cultural shifts that we cannot account for. We used 100% smoke-free restaurant legislation as a proxy for smoke-free policies across the state. Since there are municipalities with local smoke-free policies without state-wide policies,[20] we anticipate that our findings may under-estimate the true effect of smoke-free legislation on adolescent smoking. We were also not able to capture the role of smoke-free policies in households or on college/university campuses, which may influence adolescent smoking behaviors independent of state-level smoke-free policies.

Although the YRBS includes representative data on over 700,000 adolescents across 43 states, there are limitations to address. The survey is based on student self-report and there is the potential for reporting bias due to social desirability. All students are enrolled in high school and the data may not be representative of adolescents who have dropped out or are not enrolled in school. Despite reported decreases in adolescent cigarette use,[1, 2] a growing body of research has shown an increasing use of e-cigarettes.[31, 32] The YRBS does not ask about e-cigarettes until the 2015 survey. Future studies will help elucidate whether current reductions in adolescent smoking are true decreases or are being supplemented by alternative tobacco products, such as e-cigarettes. In addition, the smoking behaviors of family and friends influence adolescents' smoking and tobacco control policy changes could indirectly influence their smoking behaviors.[7] Furthermore, information on smoking intentions, important predictors of adolescent tobacco use,[33] is not collected. The YRBS

only includes questions on lifetime and current student cigarette use. Although nearly one-fifth of high school students have reported buying cigarettes in a store or gas station,[3] the majority have not purchased them legally. The YRBS does not include information on potential mechanisms and further research is needed on how these policies influence adolescent smoking behaviors.

Reducing smoking initiation and the consumption of cigarettes among smokers are critical to diminishing the burden of tobacco on population health.[2, 29] We have shown that the youngest adolescents are the most price sensitive and cigarette taxes continue to be a successful approach to reduce adolescent smoking. We found evidence that smoke-free legislation may also be an effective strategy to reduce smoking among all adolescents. If tobacco control policies continue to strengthen as we saw over the past decade, we will likely make steady progress towards our national goals.[2, 34]

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

CDC	Centers for Disease Control and Prevention
STATE	State Tobacco Activities Tracking & Evaluation
YRBS	Youth Risk Behavior Survey

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Implications and Contribution

Although state tobacco control policies have strengthened considerably over the past decade, only a few studies have examined their effects on adolescent smoking behaviors. This study found that cigarette tax increases were associated with reduced current smoking and smoking frequency for the youngest adolescents while the enactment of smoke-free legislation reduced smoking rates overall.

Table 1

Adolescent smoking and tobacco control policies by state: Youth Risk Behavior Survey, 1999–2013

	Years	N	%[a]	Mean %[a] Smoked	12/2013 Cigarette tax	1999–2013 Tax change (%)[b]	100% Smoke-free restaurants
Alabama	99–05, 09–13	9425	1.9	24.3	$0.425	83%	
Alaska	03, 07–13	6070	0.3	15.4	$2.00	42%	
Arizona	03–13	15216	2.6	19.3	$2.00	145%	5/1/2007[c]
Arkansas	99, 01, 05–13	10022	1.2	25.5	$1.15	159%	
Connecticut	05–13	10718	1.7	17.1	$3.40	383%	10/1/2003
Delaware	03–13	14498	0.3	19.1	$1.60	373%	11/27/2002[c]
Florida	03–13	29156	6.3	15.1	$1.339	180%	7/1/2003[c]
Georgia	03–13	10926	4.0	17.0	$0.37	119%	
Idaho	03–13	9774	0.7	15.0	$0.57	44%	7/1/2004
Illinois	07–13	11133	5.5	17.4	$1.98	142%	1/1/2008[c]
Indiana	03–11	9258	2.9	22.2	$0.995	355%	7/1/2012[c]
Iowa	05, 07, 11	4193	1.5	19.8	$1.36	168%	7/1/2008[c]
Kansas	05–13	8691	1.4	16.6	$0.79	134%	7/1/2010[c]
Kentucky	03–13	12549	1.7	25.3	$0.60	1319%	
Louisiana	07–13	4057	1.5	17.0	$0.36	28%	1/1/2007[c]
Maine	01–13	30019	0.6	17.2	$2.00	92%	1/1/2004[c]
Maryland	05–13	54696	2.4	13.6	$2.00	294%	2/1/2008[c]
Massachusetts	99–13	25427	2.7	19.2	$3.51	134%	7/5/2004[c]
Michigan	99–13	26174	4.5	20.0	$2.00	89%	5/1/2010[c]
Mississippi	99–03, 07–13	10889	1.2	21.9	$0.68	168%	
Missouri	99–09, 13	10993	2.6	23.6	$0.17	−29%	
Montana	99–13	24447	0.4	22.3	$1.70	570%	10/1/2005[c]
Nebraska	03, 05, 11, 13	11439	0.8	17.9	$0.64	34%	6/1/2009[c]
Nevada	99–09, 13	11992	1.0	18.5	$0.80	62%	12/8/2006[c]

	Years	N	%[a]	Mean %[a] Smoked	12/2013 Cigarette tax	1999–2013 Tax change (%)[b]	100% Smoke-free restaurants
New Hampshire	03–13	8445	0.6	18.8	$1.78	222%	9/17/2007
New Jersey	01, 05, 09–13	8309	3.7	18.5	$2.70	139%	4/15/2006[c]
New Mexico	05–13	22189	0.9	21.7	$1.66	461%	6/15/2007
New York	03–13	64160	7.6	14.5	$4.35	451%	7/24/2003[c]
North Carolina	01–13	21263	3.8	20.8	$0.45	539%	1/2/2010
North Dakota	99–13	13426	0.3	26.9	$0.44	−29%	12/6/2012[c]
Ohio	99, 03–07, 11, 13	9489	5.8	24.2	$1.25	270%	12/7/2006[c]
Oklahoma	03–13	9340	1.7	23.7	$1.03	218%	
Rhode Island	01–13	15965	0.4	15.4	$3.50	250%	3/1/2005[c]
South Carolina	99, 05–13	10378	1.9	21.6	$0.57	478%	
South Dakota	99–13	12354	0.4	28.1	$1.53	229%	11/10/2010[c]
Tennessee	03–13	11614	2.6	22.9	$0.62	238%	
Texas	01, 05–13	23635	11.7	20.8	$1.41	144%	
Utah	99–13	12218	1.4	7.5	$1.70	134%	1/1/1995[c]
Vermont	99–11	49608	0.3	20.7	$2.62	323%	9/1/2005[c]
Virginia	11, 13	7634	3.5	13.0	$0.30	751%	
West Virginia	99, 03–13	10749	0.8	26.6	$0.55	130%	
Wisconsin	99–13	17408	2.7	22.7	$2.52	203%	7/5/2010[c]
Wyoming	99–13	17597	0.3	24.7	$0.60	255%	

[a] Weighted

[b] Percentage increase in the cigarette tax in real terms from first quarter in 1999 to first quarter in 2013

[c] Also had legislation for smoke-free workplaces

Table 2

Adolescent socio-demographic characteristics and predictors of current smoking: Youth Risk Behavior Survey, 1999–2013

	N (%[a])	Mean %[a] Smoked	Adjusted OR[b] (95% CI)
Age			
14	85600 (10.3)	11.3	1.0 Referent
15	189602 (25.7)	14.9	**1.33 (1.27–1.40)**
16	192798 (26.1)	19.2	**1.82 (1.73–1.91)**
17	164096 (23.6)	22.6	**2.26 (2.15–2.38)**
18	85447 (14.4)	27.3	**2.89 (2.74–3.06)**
Race/ethnicity			
Non-Hispanic white	443034 (62.3)	22.0	1.0 Referent
Non-Hispanic Black	94094 (17.6)	10.4	**0.39 (0.38–0.41)**
Hispanic	108338 (14.4)	18.4	**0.87 (0.83–0.90)**
Non-Hispanic other	72077 (5.7)	18.6	**0.88 (0.85–0.92)**
Gender			
Female	370512 (49.9)	18.2	1.0 Referent
Male	347031 (50.1)	20.3	**1.12 (1.10–1.15)**
Year			
1999	39347 (4.1)	35.3	1.0 Referent
2001	46424 (5.6)	27.5	**0.70 (0.64–0.75)**
2003	70870 (9.7)	22.4	**0.54 (0.50–0.58)**
2005	92643 (14.8)	21.0	**0.50 (0.47–0.53)**
2007	95485 (15.5)	19.4	**0.45 (0.42–0.48)**
2009	107932 (15.3)	18.3	**0.42 (0.39–0.45)**
2011	115503 (17.9)	16.6	**0.37 (0.35–0.40)**
2013	149339 (17.2)	13.0	**0.28 (0.26–0.30)**

Values in bold type are statistically significant ($p \leq .05$).

CI = confidence interval; OR = odds ratio

[a] Weighted

[b] Models are adjusted for all variables in the table as well as state fixed effects (not shown)

Table 3

Marginal effects of the impact of state tobacco control policies on current smoking: Youth Risk Behavior Survey1999–2013

		Model 1		Model 2	
	Mean %[a] Smoked	**Marginal effect of coefficient[b]**	***p* value**	**Marginal effect of coefficient[b]**	***p* value**
All adolescents	19.3%				
Cigarette tax ($1.00)		−0.012	.08		
100% smoke-free restaurants (yes/no)		**−0.011**	**.008**	**−0.011**	**.007**
Interaction with cigarette tax ($1.00)					
Age					
14	11.3%			**−0.022**	**.005**
15	14.9%			**−0.016**	**.02**
16	19.2%			−0.014	.07
17	22.6%			−0.009	.3
18	27.3%			0.003	.8

Values in bold type are statistically significant (p ≤ .05).

[a] Weighted

[b] Model includes adjustment for the following covariates: state tobacco control expenditure, age, race/ethnicity, gender, year, and state

Table 4

Marginal effects of the impact of state tobacco control policies on smoking frequency (number of days/months cigarettes are smoked)

		Model 1		Model 2	
	Mean %[a] Smoked	**Marginal effect of coefficient[b]**	***p* value**	**Marginal effect of coefficient[b]**	***p* value**
All adolescents					
0 days	80.8%				
1–5 days	7.3%				
6–29 days	6.0%				
30+ days	6.0%				
Cigarette tax ($1.00)					
0 days		0.011	.1		
1–5 days		−0.003	.1		
6–29 days		−0.003	.1		
30+ days		−0.005	.1		
100% smoke-free restaurants (yes/no)					
0 days		**0.012**	**.005**	**0.012**	**.005**
1–5 days		**−0.003**	**.005**	**−0.003**	**.005**
6–29 days		**−0.004**	**.005**	**−0.004**	**.005**
30+ days		**−0.005**	**.005**	**−0.005**	**.005**
Interaction with cigarette tax ($1.00)					
Age – 14 years					
0 days	88.7%			**0.019**	**.01**
1–5 days	5.5%			**−0.007**	**.01**
6–29 days	3.7%			**−0.006**	**.01**
30+ days	2.1%			**−0.006**	**.01**
Age – 15 years					
0 days	85.0%			**0.013**	**.05**
1–5 days	6.6%			**−0.004**	**.05**
6–29 days	4.8%			**−0.004**	**.05**

		Model 1		Model 2	
	Mean %[a] Smoked	**Marginal effect of coefficient[b]**	***p* value**	**Marginal effect of coefficient[b]**	***p* value**
30+ days	3.5%			**−0.005**	**.05**
Age – 16 years					
0 days	80.8%			0.013	.09
1–5 days	7.2%			−0.004	.09
6–29 days	6.1%			−0.004	.09
30+ days	5.9%			−0.006	.09
Age – 17 years					
0 days	77.5%			0.010	.2
1–5 days	8.0%			−0.002	.2
6–29 days	6.9%			−0.003	.2
30+ days	7.7%			−0.005	.2
Age – 18 years					
0 days	72.7%			−0.005	.6
1–5 days	8.9%			0.001	.6
6–29 days	8.1%			0.001	.6
30+ days	10.3%			0.003	.6

Values in bold type are statistically significant (p ≤ .05).

[a] Weighted

[b] Model includes adjustment for the following covariates: state tobacco control expenditure, age, race, sex, state, and year