



The Association Between School Tobacco Control Policies and Youth Smoking Behavior

Jayani Jayawardhana¹ · Haley E. Bolton² · Monica Gaughan³

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Abstract

Background While U.S. tobacco control policy has focused mainly on tobacco excise taxes, product advertising bans, and state tobacco control policies such as indoor/outdoor smoking bans, little attention has been paid to school tobacco control policies and their impact on youth smoking behavior. Thus, the objective of this study is to examine the impact of school tobacco control policies on smoking behavior among teenagers and young adults in the USA.

Methods Using logistic regression approach, this study examines the effect of school tobacco control policies on individuals ever trying smoking and ever being a regular smoker using data from waves I, II, and III of the National Longitudinal Study of Adolescent Health.

Results Findings indicate that school tobacco control policies targeting both students and employees of the school are associated with a reduced odds of smoking initiation among youth, but do not have much effect on youth becoming regular smokers.

Conclusions If implemented properly, school tobacco control policies could play a vital role in preventing youth smoking and help reduce youth smoking rates in the country, addressing a key public health issue.

Keywords Youth smoking · School smoking policies · Tobacco control · Smoking cessation

Introduction

Since the first landmark Surgeon General Report in 1964 on *Smoking and Health*, the United States (U.S.) has made tremendous progress in smoking rates among adults by reducing it from 43% in 1965 to 14% today [1]. However, tobacco use is still known as the single most preventable cause of disease and death in the U.S., with more than 40 million individuals

dependent on tobacco usage [2]. It is estimated that about 443,000 people die each year due to tobacco-related illnesses while another 8.6 million people are likely to live with serious illnesses due to smoking. While prevalence of tobacco use among adults has been reduced in recent years, tobacco use among teenagers and young adults tends to remain high in the U.S. According to the Surgeon General's report in 2014, more than 600,000 middle school students and 3 million high school students are cigarette smokers. It also notes that nearly one in four high school seniors and one in three young adults (18–25 years) are likely to be smokers [2]. Furthermore, it reports that on each day, more than 3,200 teenagers who are younger than 18 years of age are likely to smoke their first cigarette while another 2,100 adolescents who are occasional smokers are likely to become daily smokers.

Several studies of both adults and adolescents have reported that an increase in excise taxes (or price increases) of cigarettes has a positive impact on an individual's decision to quit smoking [3–7] and a negative impact on smoking initiation among adolescents [8–12]. In addition, several studies have analyzed the impact of other public policies on smoking behavior such as smoking bans in restaurants and public places, stronger restrictions on smoking in private worksites, and

✉ Jayani Jayawardhana
jayaward@uga.edu

Haley E. Bolton
haley.bolton@emoryhealthcare.org

Monica Gaughan
monica.gaughan@asu.edu

¹ College of Pharmacy, University of Georgia, 250 West Green Street, Athens, GA 30602, USA

² Emory Healthcare, 101 W. Ponce De Leon Ave, Decatur, GA 30030, USA

³ School of Human Evolution and Social Change, Arizona State University, PO Box 872402, Tempe, AZ 85287-2402, USA

cigarette advertising bans and have reported negative effects on smoking rates among adults and adolescents [4, 12–14]. A recent study examined the effect of 100% smoke-free laws on the smoking behavior of adolescents and young adults in a longitudinal analysis [15]. They found that laws for 100% smoke-free workplaces were associated with significantly lower odds of smoking initiation, while laws for 100% smoke-free bars were associated with lower odds of being a current smoker and fewer days of smoking among current smokers [15].

While there is a vast literature evaluating the impact of tobacco taxes and other public policies on smoking behaviors among adolescents, some have also examined the relationship between school tobacco control policies and youth smoking behavior in the U.S. as well as in other countries [16–19]. In an earlier study, Wakefield and co-authors examined the relationship between smoking restrictions at home, at school, and in public places and smoking uptake and prevalence among teenagers [16]. They found that school smoking bans were related to a greater likelihood of being in an earlier stage of smoking uptake and lower prevalence only when the ban was strongly enforced [16]. Trinidad and co-authors examined the trends in the extent to which students believed that their peers and teachers complied with the school-smoking ban and support for the ban using data from a large population-based survey from California [17]. Their results indicated that perceived compliance with the no-smoking rule by most or all student smokers increased overtime, and compliance with and support for smoke-free schools increased since smoking was banned on campus for everyone [17]. Evans-Whipp and co-authors examined whether school tobacco policies were associated with differential risk of student smoking using data from Washington State in the U.S. and Victoria in Australia and found that the odds of student perception of peer smoking on school grounds decreased in schools that have strict enforcement of tobacco policy [18]. Using data on 10,325 adolescents from 50 schools in 6 European cities from 2013, Kuipers and colleagues examined the association between school smoking policies and smoking behavior among adolescents aged 14–17 and found that daily smoking was not associated with school smoking policies while smoking on school premises was less prevalent in schools with stronger staff reported total smoking policy [19].

While many researchers have studied the impact of tobacco taxes and other public policies on smoking behaviors among adolescents, none have looked at the impact of school tobacco control policies on adolescent smoking behavior in the U.S. Using data from the National Longitudinal Study of Adolescent Health (Add Health), this study examines the impact of school tobacco control policies on smoking initiation and tobacco use among teenagers and young adults in the U.S.

It is a well-known fact that tobacco usage is a major cause of many diseases, death, and increased healthcare

expenditures in the U.S. According to Centers for Disease Control and Prevention (CDC) reports, almost 9 out of 10 adult smokers started smoking before the age of 18 while 99% of the smokers start by age 26 [20]. The younger the age when a person starts using tobacco, the more likely he or she will use it as an adult and experience difficulty in quitting tobacco usage in later years. Therefore, if we can keep youth and adolescents free from tobacco usage at least until age 18, most likely they will never start using it in later years. Thus, preventing smoking initiation and increasing successful smoking cessation rates among youth and adolescents should be public health priorities. If the initiation of tobacco use among teenagers and youth in our middle and high schools could be avoided, we can expect to have a tobacco-free generation in the future.

Schools play a key role in preventing smoking initiation among youth and adolescents. Although most schools in the U.S. have some sort of tobacco control bans, they do not seem to be comprehensive. Similarly, while indoor smoking bans at secondary schools are more prevalent in most countries, outdoor smoking bans tend to be less common [21]. Rozema and colleagues note that only a few countries such as Belgium, Finland, and Australia have banned outdoor smoking on school grounds at secondary schools by law [21]. Since school is the place where they spend the most time outside of their homes, having tobacco-free environments at schools, education on harmfulness of tobacco products, and/or having restrictions on tobacco-related behavior could only help reduce initiation of smoking at young ages. Therefore, it is important to find out the effectiveness of school level tobacco control policies on youth smoking behavior. If the policies are not effective in achieving their intended goals, then public health professionals and school administrators should focus on changing current policies, and/or adopting new policies that could be effective in reducing prevalence and initiation of smoking in middle and high schools.

Methods

Data

The data used in the analysis come from the first, second, and third waves of the National Longitudinal Study of Adolescent Health. Add Health is a school-based longitudinal survey of a nationally representative sample of adolescents in grades 7–12 (ages 11–19) during the 1994–95 school year in the U.S. This Add Health cohort has been followed into young adulthood by conducting interviews in 1996 and then in 2001–2002 when the respondents were between 18 and 26 years old.

The Add Health data include information on respondents' demographic characteristics along with contextual data on the family, household, school, and friendships. The unique design

of the survey allows us to study the impact of school level tobacco control policies on youth smoking behavior while controlling for other factors. It is important to take the unique design of the survey into consideration when using and analyzing this data. Thus, using sample weights provided in the survey is important in the analysis. Following guidelines provided in Chen and Chantala (2014), we used appropriate sample weights in the analysis [22]. We excluded observations with missing weights or missing values in the variables used. Our final data sample included 7,863 observations.

Dependent Variables

Ever Tried Smoking If the respondent reported having tried smoking in any of the waves of the study, then the ever-tried-smoking variable was denoted with 1 and 0 otherwise.

Ever Being a Regular Smoker If the respondent reported having tried smoking before and then reporting being a regular smoker in any of the waves of the data where a regular smoker is defined as having smoked at least 1 cigarette every day for 30 days during any of the waves of the data, then ever being a regular smoker variable was denoted with 1 and 0 otherwise.

Independent Variables

Two key independent variables of interests are the smoking-related policies at the school level. The Add Health study included a questionnaire for school administrators, which asked (1) whether the school has no smoking policy for students and (2) whether the school district has a no smoking policy for both students and employees. These data were utilized to define the key independent variables of interests in this study as described below. In the data sample, there were a total of 124 schools of which 113 were public schools while the rest were private. Out of the public schools, 13 of them did not have a no smoking policy for students and 22 of them did not have a no smoking policy for the school district, including for employees. Out of the 11 private schools, only one school did not have either of the policies. Given the high rate of smoking bans in the sample schools, this study constitutes a conservative test of the effects of such bans.

No Smoking Policy for Students One of the key independent variables of the study—no smoking policy for students—was denoted 1 if the school reported to having no smoking policy for its students and 0 otherwise. Note that this policy does not prohibit school employees from smoking.

No Smoking Policy for All in School District, Including Employees The other key independent variable of the study—no smoking policy for all in the school district—was denoted with 1 if the school was located in a no smoking

school district and 0 otherwise. Schools in no smoking school districts have a no smoking policy for both students and employees of the school.

Other Covariates In addition to the key independent variables discussed above, a few other covariates were included in the analysis as control variables. These included gender (female = 1), age, race (White (reference group), Black (1/0), Asian (1/0), other race (1/0)), Hispanic (1/0), if they attend a public school (public school = 1), and if the school is located in a rural area (rural = 1). Since young adults are more likely to be influenced by family and household context, additional control variables at the household level were also included as control variables in the analysis. These include presence of smokers in the household (1/0), and whether the respondents have access to tobacco in the household (1/0). In addition, a measure of access to tobacco in general—the logged per capita income at the county level—was included in the analysis. Moreover, to capture the measures of tobacco control efforts in the state, the state tobacco excise tax and percent of the population that are smokers age 18 and older in the state were included as control variables.

Analysis

The analysis of the data was performed using Stata version 13. First, descriptive statistics of the data were estimated using sample weights. Then, using a regression approach, a logistic regression analysis was performed to estimate the effects of school tobacco control policies on individuals ever trying smoking. Second, conditional on individuals who have tried smoking before, another logistic regression was performed to estimate the effects of school tobacco control policies on individuals ever being a regular smoker. All logistic regression models were estimated using cluster robust standard errors at the school level.

Results

The weighted descriptive statistics of the study sample are presented in Table 1. About 51% of the sample is female and the average age of the sample is 16.4 years. About 10% of the sample is Hispanic, while 75% of the sample is White, 16% of the sample is Black, 4% of the sample is Asian, and 9% of the sample belongs to other race. About 73% of the sample reported having a smoker in the household while about 42% of the sample reported having access to tobacco in their households. About 93% of the sample schools were public and about 19% of the sample schools were located in rural areas. About 77% of the sample schools are located in a no smoking school district, and 91% of the sample schools have no smoking policies for students. The average excise tax across

Table 1 Weighted descriptive statistics

Variable	Obs	Mean	Std. error	95% CI	
Ever tried smoking (1/0)	7863	0.809	0.008	0.794	0.825
Ever being a regular smoker (1/0)	5288	0.644	0.012	0.620	0.668
Cessation after being a regular smoker (1/0)	2953	0.173	0.010	0.153	0.193
Female	7863	0.508	0.008	0.492	0.525
Age	7863	16.443	0.119	16.207	16.679
Hispanic	7863	0.101	0.015	0.071	0.130
White	7863	0.747	0.028	0.693	0.802
Black	7863	0.160	0.023	0.115	0.205
Asian	7863	0.043	0.009	0.026	0.061
Other race	7863	0.092	0.011	0.070	0.114
Presence of smokers at home	7863	0.734	0.009	0.716	0.752
Access to tobacco at home	7863	0.419	0.011	0.397	0.440
Public school	7863	0.931	0.021	0.888	0.973
Rural	7863	0.192	0.051	0.092	0.292
No smoking policy for students at school	7863	0.907	0.026	0.857	0.958
No smoking school district	7863	0.772	0.050	0.674	0.870
Excise tax	7863	0.309	0.016	0.278	0.340
Per capita income (1000s)	7863	13.355	0.259	12.842	13.866
Percent of smokers (age 18+)	7863	0.237	0.002	0.233	0.241

Source: Add Health Data

states is \$0.31, average per capita income at the county level is around \$13,355, while on average, 23.7% of the state population aged 18 and older are smokers.

Table 2 presents the results from the logistic regression analyses. The coefficients, Z statistic, P value, and odds ratios of the logistic regression results are presented. The regression results indicate both negative and statistically significant effects of being in a no smoking school district on adolescents ever trying smoking ($p < 0.05$). Having a no smoking policy only for students at schools seems to have a negative effect on adolescents ever trying smoking although it is not statistically significant. In addition, having access to tobacco in the household, the presence of smokers in the household, and a higher percent of smokers in the state (age 18 and older) have positive and significant effects on adolescents ever trying smoking ($p < 0.05$). Furthermore, being female or Black has negative and statistically significant impacts on adolescents ever trying smoking ($p < 0.05$), while being other race seems to have positive and statistically significant effect on adolescents ever trying smoking ($p < 0.05$) in comparison with Whites.

Regression results in the second column of Table 2 indicate that no smoking policies—either at the school or district levels—do not have any effect on being a regular smoker. However, presence of smokers in the household, having access to tobacco in the household, and a higher percent of smokers in the state (age 18 and older) have significant ($p < 0.05$) and positive effects on being a regular smoker. Moreover, being female, Hispanic, Black, or Asian seem to

have negative and statistically significant effects on being a regular smoker.

Discussion

Because it is imperative to prevent people from initiating smoking during their adolescent years, the school is an important focus of anti-smoking interventions. When adolescents avoid trying smoking in the first place, they will not proceed to become regular smokers. The results support that policies that limit smoking in schools reduce the opportunities for adolescents to be around tobacco and its use. It is noteworthy that the results indicate that district-level school tobacco control policies that prohibited smoking by adults and adolescents alike are effective in reducing initiation of smoking among youth. Policies that only target students at the school level are not effective in decreasing initiation of smoking; it may be that tobacco is still present and being used by adults, who turn out to be powerful proximate determinants of smoking behavior by adolescents.

Important determinants of initiation of smoking, as well as maintaining regular smoking, and being less likely to quit smoking are all related to the presence of household members who smoke at home, and its availability to the adolescent at home. In this context, policies that affect the availability of tobacco products to all—adolescents and adults alike—are

Table 2 Logistic regression results on smoking initiation and on being a regular smoker

Variables	Ever tried smoking				Ever being a regular smoker			
	Coef.	z stat	P value	Odds ratio	Coef.	z stat	P value	Odds ratio
Female	−0.19	−2.86	0.00	0.83	−0.27	−3.83	0.00	0.76
Age	0.02	1.02	0.31	1.02	−0.01	−0.72	0.47	0.99
Hispanic	−0.15	−0.79	0.43	0.86	−0.47	−2.56	0.01	0.62
Black	−0.48	−4.50	0.00	0.62	−0.89	−9.55	0.00	0.41
Asian	−0.32	−1.85	0.07	0.73	−0.36	−2.47	0.01	0.70
Other race	0.29	2.77	0.01	1.33	0.04	0.29	0.77	1.04
Presence of smokers at home	0.44	6.88	0.00	1.55	0.34	4.16	0.00	1.40
Access to tobacco at home	0.44	6.31	0.00	1.55	0.45	6.46	0.00	1.57
Public school	0.21	1.42	0.16	1.24	0.13	1.47	0.14	1.14
Rural	0.07	0.85	0.40	1.07	−0.01	−0.10	0.92	0.99
No smoking policy for students	−0.20	−1.37	0.17	0.82	−0.22	−1.76	0.08	0.80
No smoking school district	−0.18	−2.05	0.04	0.83	−0.08	−0.91	0.36	0.92
Excise tax	0.53	1.84	0.07	1.69	0.06	0.25	0.80	1.06
Log (per capita income)	0.05	0.25	0.80	1.05	0.06	0.28	0.78	1.06
Percent of smokers (age18+)	4.66	2.16	0.03	105.38	4.66	2.78	0.01	105.49
Constant	−0.54	−0.52	0.61	0.59	−0.47	−0.53	0.59	0.63
N	7863				5288			
Wald Chi ² (15)	197.58				390.55			

much more likely to result in reductions in initiation of smoking during the vulnerable adolescent years.

Limitations

The results showed that no smoking policies do not have much effect on youth becoming regular smokers. One interpretation is that the experience of addiction, once it takes hold through regular use, is not well controlled by school-level general environmental public health controls. Also plausible is related to a limitation in the way regular use was operationalized in this study. Specifically, these were determined later in the life course, often (in the case of regular smoking) long after exposure to the high school policy environment. Clearly, school smoking policies do have an effect on trying smoking while students are in school, but they do not have an apparent effect on smoking behavior later in life. Ideally, there should be a measure of institutional smoking policies affecting respondents throughout their life course to assess contextual effects on the maintenance and cessation process. Also, it should be noted that these results indicate only an association of smoking policies on outcome variables and do not indicate causal effects.

Conclusions

Much has changed in the United States since 1994. Most noteworthy relative to this research is the continuing spread

of no smoking policies throughout the United States. These no smoking policies affect many kinds of public and private spaces and infringe on smoking in substantive ways that were unimaginable in 1994. From that perspective, this research—on the effect of smoking bans at the beginning of the period on a particular segment of the US population—adds support to the wisdom of making smoking difficult in as many contexts as possible. This makes smoking unattractive, reduces exposure to smoking “role models,” and makes it harder to get access to tobacco and tobacco products. Together, these are going to make it ever more unlikely that adolescents will start smoking in the first place.

We note that a critically important recent period factor is the rise of electronic cigarettes in the youth population. The federal government has only recently introduced a ban on sales of e-cigarettes to youth under 18. This will certainly help reduce access, but it is also the case that e-cigarettes are easy to conceal, even in no-smoking environments. Research is only just emerging about the e-cigarette threat to youth, but it must continue. The gains in recent years of youth smoking must not be lost to new methods of introducing youth to nicotine addiction, which initiates a process that is not well controlled with a simple ban.

It is noteworthy that extant studies of smoking bans have been completed in high-income countries. We end this manuscript by considering how smoking bans have the potential to improve health and well-being throughout the world. The WHO Framework Convention on

Tobacco Control (2005) encourages countries to adopt a number of tobacco control policies, including those known to reduce youth smoking. Forty-nine countries have passed comprehensive indoor smoking bans; these countries represent only one-third of the signatories to the treaty and only one-quarter of all countries [23]. Youth in low- and middle-income countries—where the majority of the world’s people live—are especially unlikely to live in policies with smoking bans [23]. Furthermore, policies do not translate into implementation and enforcement; in 2009, only 2% of the world’s population was estimated to live under high-compliance smoking ban regimes [24]. The findings of this research indicate that smoking bans—particularly those targeting youth environments—reduce the incidence of youth tobacco use. Sustainable Development Goals—and the Millennium Development Goals before them—are bringing unprecedented numbers of boys and girls into educational systems; the implications of this are that youth well-being will be furthered by the adoption and implementation of smoking bans, particularly in educational settings. An important implication of this work is the need to expand our focus beyond high-income countries to settings where the majority of youth smoking occurs, and about which the public health community knows little.

Finally, the findings also suggest that policy makers should focus their attention on family and community factors that affect youth behavior related to tobacco use. Reducing smoking among adults is likely to result in lower youth smoking rates overall since living around smokers and smoking have such big effects on maintaining smoking for adolescents. Turning again to the WHO Framework Convention on Tobacco Control, we note that a number of policy mechanisms are designed to reduce smoking prevalence. Policies that make it difficult to start smoking (such as the ones we focus on here) are not the same as those that make it easier to quit an addiction once it has become established. Article 14 calls for providing services to reduce nicotine dependence, but only a slight majority of signatories do so, while low and middle income countries (LMIC) have made little progress [23]. There is generally a lack of access and coverage for effective pharmacological interventions, an issue that affects LMICs as well as wealthy countries such as the United States that lack coverage for medication management. Effective national cessation programs include short- and long-term interventions through the clinical system, as well as consistent messaging and support from the public health sector [23]. Therefore, it is important to conduct research to assess how policies related to smoking cessation can be extended, as these types of interventions are most effective in reducing smoking among adults.

Implications for School Health

Total school smoking bans are effective control policies for preventing youth smoking and will help reduce youth smoking rates in the country if implemented properly across all school districts. Thus, it is crucial for policy makers to understand the effectiveness of school tobacco control policies on youth smoking behavior. This study brings our attention to this important policy discussion and highlights the importance of implementation of effective policies in curbing smoking among adolescents.

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Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Research Involving Human Participants and/or Animals This research is a secondary data analysis and does not involve any human subject participants or animals.

Informed Consent Since this research involves only a secondary data analysis, the researchers collected no primary data, thus researchers for this study collected no consent.

Human Subject Approval Statement This study was approved by the Institutional Review Board at the University of Georgia.

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