



*A Policy Research Partnership
to Reduce Youth Substance Use*

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ABSTRACT

Objectives - To determine the relationship between extent of restrictions on smoking at home, at school and in public places, and smoking uptake, smoking prevalence and monthly cigarette consumption by school students.

Design - Cross-sectional survey with merged records of extent of restrictions on smoking in public places.

Setting – United States.

Participants – 17,287 high school students.

Main outcome measures – Five-point scale of smoking uptake; 30-day smoking prevalence; monthly cigarette consumption among current smokers.

Results – More restrictive arrangements on smoking at home were associated with a greater likelihood of being in an earlier stage of smoking uptake ($p < .05$), lower 30-day prevalence ($p < .001$) and reduced monthly cigarette consumption ($p < .001$). These findings applied even where parents were smokers. More pervasive restrictions on smoking in public places were associated with a higher probability of being in an earlier stage of smoking uptake ($p < .05$), lower 30-day prevalence ($p < .05$), but not reduced consumption. School smoking bans were only related to a greater likelihood of being in an earlier stage of smoking uptake ($p < .05$), lower prevalence ($p < .001$) and reduced consumption ($p < .006$), when the ban was strongly enforced, as measured by instances when teenagers perceived that most or all students obeyed the rule.

Conclusions - These findings suggest that restrictions on smoking at home, more extensive bans on smoking in public places and enforced bans on smoking at school may reduce teenage smoking.

INTRODUCTION

There is good evidence that restrictions on smoking at work are associated in adults with reduced daily smoking rate and increased cessation.(1) A more recent thread of research suggests that home smoking restrictions are associated in adults with attempts to quit in the past year, six-month cessation and lower smoking rate.(2,3) Restrictions on smoking in public places and at home are increasingly being observed at least in the United States and Australia.(1,4,5) As these types of smoking restrictions become more pervasive, and as the tobacco industry fears, it is likely that smoking will be perceived as more socially unacceptable and more inconvenient.

This raises the question of whether these types of smoking restrictions influence the uptake and consolidation of smoking among teenagers. As yet, there has been little study of how public places policies relating to smoking restrictions might influence teenage tobacco use.(6-8) A study in 1993 in Massachusetts, United States, found no relationship between home smoking restrictions and teenage smoking.(9) But, as these investigators recognized, bans on smoking in the home were relatively uncommon in 1993, applying to only 25% of households. Furthermore, the study had a small sample size with which to detect such differences. Banning smoking in the home, even where parents are smokers themselves, gives an unequivocal message from parents to teenagers about the unacceptability of smoking, as do restrictions on smoking in public places. In a climate

of more prevalent restrictions both at home and in public places, there is good reason to expect that there may be a protective effect of smoking restrictions on teenage smoking uptake.

It has also been suggested that exposure to environmental tobacco smoke (ETS) during childhood may increase tolerance for tobacco smoke and make children sensitized to taking up active smoking in their teenage years by reducing the noxious deterrence of the first cigarette.(10) This implies that children who are exposed frequently to ETS - such as those with parents who smoke at home - might have an increased likelihood of progressing through the uptake continuum of smoking to become an established smoker.

In terms of restrictions on smoking at school, it is known that schools with policies that have a comprehensive approach to smoking, including enforcing bans on smoking on school premises, have significantly lower rates of student smoking.(11,12) However, while bans on smoking in schools are common, they are poorly complied with, so enforcement is highly important.(13)

This study sought to determine the relationship between smoking restrictions in the home, at school and in public places, and measures of uptake of smoking, smoking prevalence and monthly cigarette consumption by teenagers.

METHODS

Subjects and sampling technique

The data used for this study were from a survey of United States school students in grades 9 to 12 (aged 14 to 17 years) administered in the Spring of 1996. A three-stage sampling procedure was used, which over-sampled African American, Hispanic and high school students in low income areas. The primary sampling units were counties of the mainland United States and 100 counties were selected with probability proportional to population. In addition to this procedure, 100 additional counties were selected from a sampling frame of 40 counties most populated with African Americans, 40 most populated with Hispanic Americans and 20 most populated with low income earners, as signified by a median household income value of US\$15,000 or less. Within each selected primary sampling unit, one school was selected with probability proportional to enrolment in grades 9 through 12. Four substitute schools were drawn within each of the 200 primary sampling units, so that they would match the selected school with respect to degree of urbanization, type and size of school, percent minority enrolment, and income level.

When a selected school declined to participate in the survey, one of the four substitutes associated with that school was contacted to attempt to gain participation. If cooperation of the first substitute school could not be gained, negotiations were begun with the second substitute school. There were some primary sampling units where selected schools could not be recruited into the study, as refusals sometimes occurred at the school district level, meaning that many of the substitute schools were immediately lost since they fell within the same school district area of jurisdiction. When the list of substitute schools within a primary sampling unit was exhausted, an attempt was made to find a substitute school within an adjacent county. If this was unsuccessful, an attempt was made to find a substitute school in another primary sampling unit that matched to the primary sample school with respect to degree of urbanization, percent minority enrolment, type and size of school and income level.

At each selected school, school personnel were asked to compile a roster of the classrooms having a subject that was required for the grade. One classroom was drawn from the submitted roster for each of grades 9 through 12 present at the school and all students who were members of the classroom were eligible to participate in the survey.

At the school level, 73 percent of the schools selected as primary sample or reserve sample (4 reserve schools for each primary selection) participated in the survey. At the student level, 80 percent of the students in sampled classrooms completed a survey

questionnaire, yielding 17,287 questionnaires. An overview of the sampling method and response rates is found in Figure 1.

Questionnaire measures

Descriptors of the survey sample included gender; grade at school (9 through 12); race (African American, Hispanic, White, other); whether adults living in the home were smokers (yes or no); whether the respondent had siblings who smoked (yes or no).

Respondents were classified by stage of smoking uptake, on the basis of specific responses to questions on smoking history and intentions to smoke in future, which have been found to predict current smoking at 3-4 year follow-up.(4,14) ‘Nonsusceptible nonsmokers’ had never smoked a cigarette, even a puff, and had a strong intention not to do so in future. ‘Susceptible nonsmokers’ had never smoked a whole cigarette but had weak intentions to stay nonsmokers or they had previously had a puff, but had strong intentions to stay nonsmokers. ‘Early experimenters’ had puffed on a cigarette before the past thirty days but had weaker intentions not to smoke in future, or had smoked a whole cigarette before the past thirty days and had strong intentions not to smoke in future. ‘Advanced experimenters’ had smoked a whole cigarette before the past thirty days and had weak intentions not to smoke in future or had smoked in past thirty days, but had never smoked 100 cigarettes. Irrespective of their future intentions or recent smoking

activity, respondents who indicated they had smoked 100 cigarettes in their lifetime were classified as ‘established smokers’. In addition, current smoking was defined by the traditional measure of having smoked in the past thirty days. Respondents who had smoked in the past 30 days, were asked on the days they smoked, how many cigarettes they smoked per day, and on how many of these 30 days they had smoked. By multiplying average daily consumption by the number of days smoked, we derived a monthly consumption measure. This measure went some way towards capturing the variation in day to day consumption that is known to exist among teenage smokers.

Home smoking restrictions were defined by responses to the question “how is cigarette smoking handled in your home?” with response options being coded as a total ban (“no-one is allowed to smoke in my home”), some restrictions (“only special guests are allowed to smoke in my home” or “people are allowed to smoke only in certain areas in my home”) and no restrictions (“ people are allowed to smoke anywhere in my home”). Two measures of school smoking restrictions were constructed from questions which asked about whether there was a ban on smoking at their school, and if so, how many students obeyed the rule. These included whether a ban existed (school ban; no school ban) and whether a school ban was strong (a ban exists and most or all students comply) or weak (a ban exists but few or no students comply, or no ban).

Based on school identifiers, information on state, county and city laws relating to restrictions on smoking were added to the database for the 202 school sites in the survey. State laws applying in 1996 were collated from records held by the Centers for Disease Control and Prevention,(15) and county and city data were acquired from unpublished databases maintained by the American Nonsmokers Rights Foundation, in San Francisco, California. Where county or city laws were stronger than state laws, these took precedence. We defined ‘strong public places restrictions’ where there were restrictions in private worksites *and* restaurants, ‘moderate public places restrictions’ where there were restrictions in *either* private worksites or restaurants and ‘weak public places restrictions’ where there were restrictions in neither of these environments.

Statistical analysis

Data were analyzed using SAS Version 6.12 and MIXOR/MIXREG.(16) We initially used cumulative logit analysis to examine the relationship between stage of uptake and extent of restrictions, but found that for some variables, the proportional odds assumption was not met. Therefore, we performed a thresholds of change analysis, which allows for some variables to have varying effects on each stage of uptake of smoking.(17) Since there are five stages of smoking uptake, there are four thresholds that separate these stages. Logistic regression analysis was used to examine the association between smoking status and smoking restrictions and linear regression was used to examine the

association between monthly cigarette consumption and smoking restrictions. Because this variable was highly skewed, we used a logarithmic transformation, which normalized the distribution. Each analysis adjusted for school grade, gender, whether adults at home were smokers, and whether siblings smoked. Due to the multi-stage sampling method, we ran random-effects intercepts models for all three analyses, which adjusted our standard errors to account for the clustering.

Initially, we performed a listwise deletion for independent variables that had missing data, yielding 15,341 cases for analysis. With the exception of public places restrictions, for each independent variable, there were less than 4% of cases that were missing. For the public places restrictions, a total of 70 out of the 202 sites had missing data on the combined CDCP/ANRF database, and when this was merged with the school survey data, it resulted in 4,574 missing cases. Where missing data exist, it is more likely than not, that there are simply no public places restrictions in existence in the location. In preliminary analyses, we ran separate models which excluded all missing data, and found very similar results in terms of direction and size of effect and significance levels, suggesting that most of the missing data could safely be treated as ‘no restrictions’. For this reason, in our final model, we assigned a value of ‘no restrictions’ to the missing cases, so that we could retain them for analysis. In addition, we performed listwise deletion for missing data for the dependent variables for each analysis, resulting in 14,977 cases for the smoking uptake analysis, and 14,746 for the smoking prevalence

analysis. For the cigarettes per month analysis, the final model included 3,934 cases, excluding 698 missing cases. Since the percentage of missing cases for this variable was relatively high, we ran models assuming that all missing cases smoked one cigarette per day on days smoked (the median value), which did not change the pattern of findings, so we concluded that excluding missing cases in our final model did not affect results.

RESULTS

Table 1 shows the characteristics of respondents and the prevalence of smoking restrictions that applied to them. In addition, 28% of teenagers (n=14,746) had smoked in the past 30 days. Among those who had smoked in the past 30 days, mean cigarette consumption was 138.8 cigarettes per month (sd=214.7), with a range of 1 to 240 per month (n=3,934).

Insert Table 1 about here

Table 2 shows that, after adjusting for covariates, there was a non-proportional relationship between stage of smoking uptake and extent of restrictions on smoking in public places. For the first two thresholds, there was no protective effect introduced by more extensive public places restrictions, but having stronger restrictions reduced the

odds of crossing the ‘advanced experimenter’ threshold by 8% and of crossing the ‘established smoker’ threshold, by 10%. Thus, more extensive restrictions on smoking in public places were associated with a lower probability of smoking uptake, but this mostly occurred by reducing the probability of transition at later, rather than earlier, stages of uptake. Total bans on smoking at home had a much greater effect than bans in public places on uptake of smoking. Total bans exerted a relatively greater impact on the earlier, rather than later, stages of smoking uptake, but significantly reduced the probability of transition at all thresholds. Having some home restrictions also reduced the likelihood of smoking uptake, but the effect was less than for total home bans - 17% at each threshold - and was constant across the stages. The existence of a ban on smoking at school was not associated with smoking uptake until the last stage, where it was found to be associated with a greater likelihood of being an established smoker. However, enforced school bans were associated with reduced uptake of smoking by a constant factor of 11% across the stages of uptake. There were no significant interactions between parental smoking and home bans, or between bans in different environments, on the probability of smoking uptake.

Insert Table 2 about here

Table 3 shows that in relation to smoking prevalence, stronger public places restrictions had a significantly protective effect on smoking prevalence, and that a total ban and some

restrictions on smoking at home had a stronger protective effect. The existence of a school ban had no effect on smoking prevalence, but strong school bans were associated with reduced smoking prevalence. There were no significant interactions between parental smoking and home bans, or between bans in different environments, on the probability of being a smoker.

Insert Table 3 about here

Table 4 shows that, after adjusting for covariates, stronger public places bans, and the existence of a school ban had no effect on monthly consumption, but that a total ban and some restrictions on smoking at home, and enforced bans on smoking at school were associated with reduced monthly consumption. Again, there were no significant interactions with parental smoking, or between bans in different environments and cigarette consumption.

Insert Table 4 about here

DISCUSSION

To the best of our knowledge, this study is the first to examine the relationship between smoking restrictions in a range of environments on the smoking behavior of teenagers. The results suggest that stronger restrictions on where cigarettes may be smoked, in public places and at home, are associated with a greater likelihood of being in earlier stages of uptake of smoking, and with lower smoking prevalence among teenagers. Restrictions on smoking at home have a relatively greater effect than restrictions in public places. Strongly enforced school smoking bans, as measured by instances when teenagers perceived that most or all students obeyed the rule, were associated with reduced uptake and lower smoking prevalence. Bans and restrictions on smoking at home, and strongly enforced bans at school, but not restrictions in public places, were related to lower monthly cigarette consumption.

These findings are subject to at least four limitations. First, these data are from a cross-sectional survey, which limits attributions about the direction of causality between variables. There may be other factors that influence teenage smoking, as well as restrictions on smoking in these different environments, leading to an artificial relationship between restrictions and youth smoking. For example, in places where stronger restrictions exist on smoking in public places, the environment for tobacco control may be more favorable and there may be a range of other policy influences that promote lower smoking rates by teenagers and we have not controlled for these. However, we did control for adult smoking, which is also likely to be influenced by these

policies and found little change in the model parameters and no interactions with adult smoking.

Second, we used a previously untested classification for public places laws that seemed to us to reflect the strength of smoking restrictions. We ran preliminary analyses with a 5-point scale developed in the 1980's that has previously been used to rate the strength of public places laws for previous US Surgeon-General's reports.(8,18) We found a similar pattern of findings to the analyses reported here, although we were concerned about using the older scale because it produced a ceiling effect, with most cases loading at the strongest possible level. Our three-point measure better captured the progress that has been made over the last decade in implementing restrictions on smoking in public places.

Third, we had no information about the duration of the restrictions in any of the environments we examined, and it may be that effects change over time as teenagers accommodate to a more restrictive environment. Finally, we did not have measures of actual enforcement of, or compliance with, laws restricting smoking in public places. However, studies of restrictions on smoking at work and in other public places such as restaurants, suggest that they have high levels of compliance.(19-22)

Notwithstanding these cautions, our finding of a protective effect offered by home smoking bans on smoking uptake, prevalence and consumption is consistent with

research from Europe and the United States that parental opposition to smoking, and the setting of clear standards about smoking, seem to be more important predictors of teenager's intentions to smoke, than is parental smoking behavior.(23-25) Our results apply both where parents do and do not smoke, suggesting that even if parents are unable to quit smoking to set a good example for their children, limiting where smoking may occur at home, and especially banning smoking completely, may reduce the likelihood of teenage smoking uptake. By comparison, stronger public places restrictions are likely to have a more modest effect, which is nonetheless statistically significant.

Among confirmed teenage smokers, public places restrictions were unrelated to monthly consumption. This finding is quite contrary to those reported for adults.(1) This is likely to be because teenagers spend little or no time in many of the places where smoking is banned, such as workplaces and restaurants. Further, teenager's cigarette consumption is still low compared to that of adults, so they may not be unduly inconvenienced when they are in these environments.

For school bans, it was notable that protective effects were only observed when there were strong as opposed to weak school bans and these applied also to consumption. This is generally consistent with the literature, and underscores the importance of enforcing smoke-free policies in schools.(11-13)

Overall, these findings suggest that placing restrictions on where cigarettes may be smoked, especially at home, does influence teenage smoking. These findings require further examination in longitudinal studies, which also control for the existence of other tobacco control policies that may have an influence on youth smoking.

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Table 1: Characteristics of respondents.

	Percent (n=15,341)
Grade at school:	
9	25.5
10	28.4
11	25.0
12	21.2
Gender:	
Male	46.5
Female	53.5
Race/ethnicity:	
White	47.1
African American	20.1
Hispanic	23.4
Other	9.5
Restrictions in public places:	
Strong restrictions	57.1
Moderate restrictions	18.9
Weak restrictions	24.0
Restrictions at home:	
Total ban	48.2
Some restrictions	27.2
No restrictions	24.6
School ban:	
Ban exists	91.8
Ban does not exist	8.2
School ban enforcement:	
Strong ban	28.3
Weak or no enforcement of ban	71.7
Stage of smoking uptake:	(n=14,977)
Nonsusceptible nonsmoker	26.4
Susceptible nonsmoker	12.7
Early experimenter	19.2
Advanced experimenter	21.6
Established smoker	20.1

Table 2

Thresholds of change analysis: Odds ratios (and 95% confidence intervals) for association of restrictions with stages of smoking uptake

	Susceptible Nonsmoker Threshold	95% CI	Early Experimenter Threshold	95% CI	Advanced Experimenter Threshold	95% CI	Established Smoker Threshold	95% CI
Public place restrictions	0.96	0.86-1.06	0.93	0.84-1.02	0.92* ⁺	0.83-1.00	0.90* ⁺	0.81-0.98
Total home ban	0.64*	0.52-0.76	0.69* ⁺	0.59-0.79	0.71* ⁺	0.60-0.82	0.78* ⁺	0.67-0.90
Some home restrictions	0.83*	0.74-0.92	0.83*	0.74-0.92	0.83*	0.74-0.92	0.83*	0.74-0.92
School ban	0.92	0.77-1.08	0.98	0.85-1.10	1.07	0.93-1.21	1.22* ⁺	1.07-1.37
Enforced school ban	0.89*	0.85-0.99	0.89*	0.85-0.99	0.89*	0.85-0.99	0.89*	0.85-0.99

2logL=35,559.3 (df=57), ICC=.042, cluster variance =.143, p<.00000.

N=14,977; adjusted for school grade, sex, race, adult smokers in home, and sibling smokers.

* Odds ratio is significantly different from 1.0 (p<.05).

⁺ Odds ratio is significantly different from odds ratio at first threshold (p<.05).

Table 3: Logistic regression analysis: Odds ratios (and 95% confidence intervals) for association of restrictions with 30-day smoking prevalence

	OR	95% CI	p value
Public place restrictions	0.91	0.83 - 0.99	0.03
Total home ban	0.79	0.67 - 0.91	<.001
Some home restrictions	0.85	0.74 - 0.95	<.01
School ban	0.99	0.85 - 1.13	0.86
Enforced school ban	0.86	0.77 - 0.94	<.001

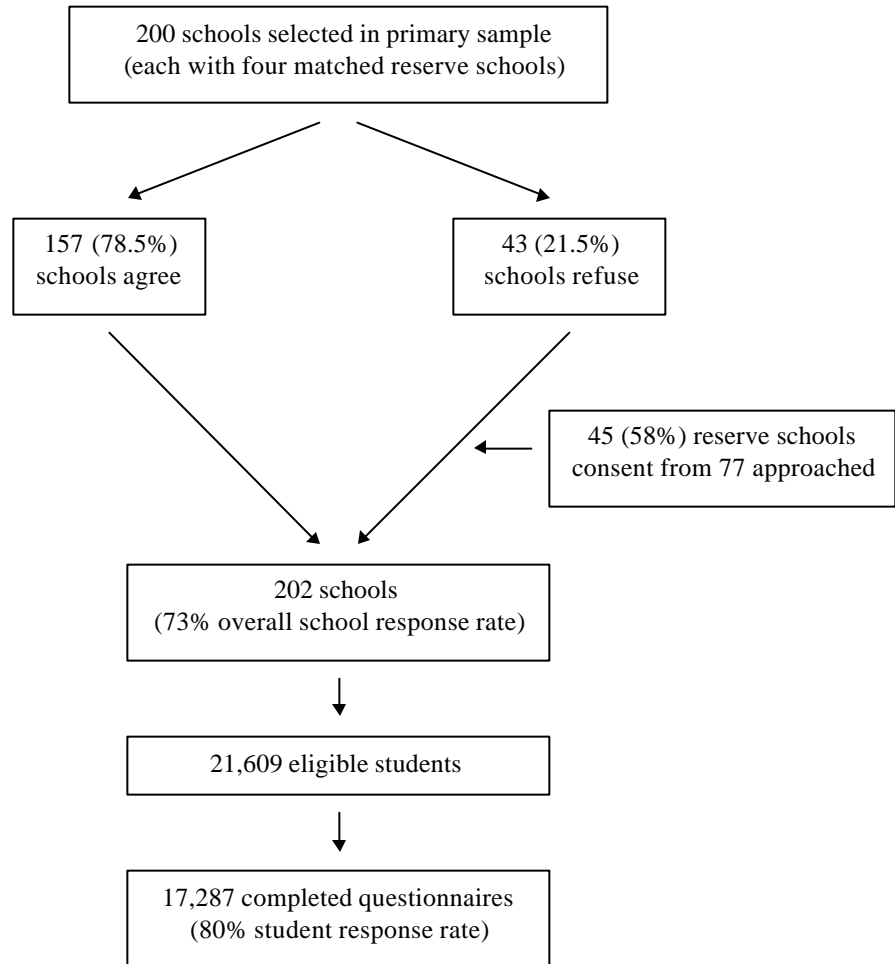
2logL=16,271.0, (df=16), ICC=.038, cluster variance =.131, p<.00000.
 N=14,746; adjusted for grade, sex, race, adult smokers in home, and sibling smokers

Table 4: Multiple regression analysis: parameter estimates for association of restrictions with monthly cigarette consumption

	Estimate	CI	p value
Intercept	21.931	15.216-31.595	0.0001
Public place restrictions	0.957	0.872 - 0.953	0.35
Total home ban	0.659	0.564 – 0.771	<.0001
Some home restrictions	0.760	0.654 – 0.884	<.0004
School bans	1.186	0.936 – 1.504	0.16
Enforced school ban	0.829	0.725 – 0.948	<.006

2logL=15,744.7 (df=16), ICC=.043.
 N=3,934; adjusted for grade, sex, race, adult smokers in home and sibling smokers.

Figure 1: Survey sampling strategy and response rates



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