study 10% (38) of participants unwilling or unable to stop smoking at baseline were abstinent at two years clearly gives support to the idea that smoking reduction can be a step towards abstinence.

Another caveat is that smokers who reduce their number of daily cigarettes may compensate their intake of tobacco toxins by smoking the remaining cigarettes more efficiently. The present study indicates that such compensation may occur to some extent because the reduction in carbon monoxide concentrations was lower than the corresponding reduction in cigarette consumption.

In summary, our study shows that sustained, long term reduction in smoking with the nicotine inhaler can be achieved and maintained. Smoking reduction seems a feasible first step towards improved health and may ultimately lead to complete smoking cessation in people unable or unwilling to stop smoking abruptly.

Contributors: CTB was involved in planning the study, wrote the paper, and was principal investigator for Basle. J-PZ was involved in planning the study and was principal investigator for Lausanne. TD was involved in planning, helped to write the paper, and was responsible for the trial at Pharmacia and Upjohn, Sweden. XvB was involved in planning and was the main study nurse for Basle. AR was the main study nurse for Lausanne. ÅW carried out the statistical analysis. APP was involved in planning and supervision during the study. US was senior study planner at Pharmacia and Upjohn, Sweden. CTB is guarantor for the study.

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Competing interests: TD, ÅW, and US are all employed by Pharmacia and Upjohn, Sweden, and AR, CTB, and J-PZ have received funds for research from them.

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Effect of restrictions on smoking at home, at school, and in public places on teenage smoking: cross sectional study

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Abstract

Objective To determine the relation between extent of restrictions on smoking at home, at school, and in public places and smoking uptake and smoking prevalence among 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.

Results More restrictive arrangements on smoking at home were associated with a greater likelihood of being in an earlier stage of smoking uptake ($P<0.05$) and a lower 30 day prevalence (odds ratio 0.79 (95% confidence interval 0.67 to 0.91), $P<0.001$). These findings applied even when parents were smokers. More pervasive restrictions on smoking in public places were associated with a higher probability of being in a earlier stage of smoking uptake ($P<0.05$) and lower 30 day prevalence (0.91 (0.83 to 0.99), $P=0.03$). School smoking bans were related to a greater likelihood of being in an earlier stage of smoking uptake (0.89 (0.85 to 0.99), $P<0.05$) and lower prevalence (0.86 (0.77 to 0.94), $P<0.001$) only 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

Restrictions on smoking at work and home are associated in adults with reduced daily smoking rate and increased cessation.[1-3] As these types of smoking restrictions become more pervasive,[1 4 5] smoking is

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likely to be perceived as more socially unacceptable and inconvenient. As yet, there has been little study of how smoking restrictions in public places might influence teenage use of tobacco.[6–9]

Banning smoking in the home, even when parents smoke, gives an unequivocal message to teenagers about the unacceptability of smoking, as do restrictions on smoking in public places. Exposure to environmental tobacco smoke during childhood has been suggested to increase tolerance for tobacco smoke and sensitise children to taking up active smoking in their teenage years by reducing the noxious deterrence of the first cigarette.[10] Thus, children who are exposed more often to parents smoking inside the home might have an increased likelihood of becoming established smokers.

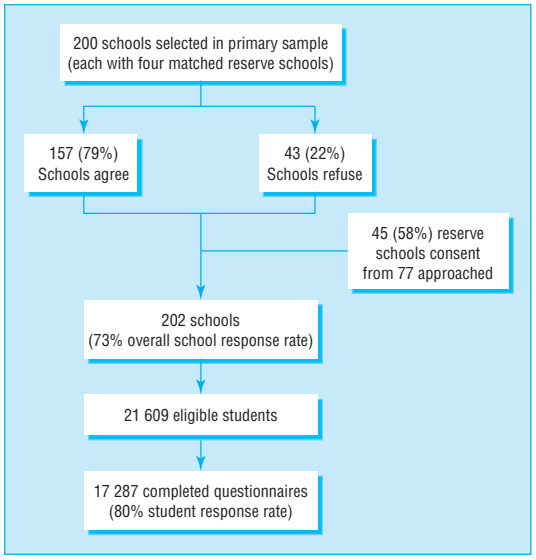
Schools with smoking policies have significantly lower rates of student smoking,[11 12] but although school smoking bans are common, they are poorly complied with, so enforcement is highly important.[13] We sought to determine the relation between smoking restrictions in the home, at school, and in public places and measures of uptake of smoking and smoking prevalence by teenagers.

Participants and methods

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, with the primary sampling units being counties of the mainland United States. Within each selected primary sampling unit, one school was selected with probability proportional to enrolment in grades 9 through 12. Four reserve schools were drawn for each school in the primary sample; they were matched to selected schools by degree of urbanisation, type and size of school, percentage of children from ethnic minorities, and income level. When a selected school declined to participate, one of the matched reserve schools was asked to take part. At each selected school, one class was selected from each grade, and all students in these classes were eligible to participate in the survey. The figure shows that 73% of the schools selected as the primary or reserve sample participated in the survey and 80% of the students in sampled classes completed a survey questionnaire, yielding 17 287 questionnaires. Students were informed in writing that the survey was voluntary and that responses would remain confidential. The study design and questionnaire were approved by a Robert Wood Johnson Foundation advisory panel containing independent researchers with experience in conducting youth surveys about smoking.

Questionnaire measures

Descriptors of the survey sample included sex; school grade (9-12); race (African American, Hispanic, white, other); whether adults living in the home were smokers (yes or no); and whether the respondent had siblings who smoked (yes or no). We classified respondents by stage of smoking uptake on the basis of specific responses to questions on smoking history and intentions to smoke in future that have been found to predict current smoking at follow up after three to four years.[4 14] "Non-susceptible non-smokers" had never smoked a cigarette, even a puff, and had a strong intention not to do so in future. "Susceptible non-smokers" had never smoked a whole cigarette but had weak intentions to stay non-smokers or they had previously had a puff but had strong intentions to stay non-smokers. "Early experimenters" had puffed on a cigarette more than 30 days before the survey but had weaker intentions not to smoke in future or had smoked a whole cigarette more than 30 days before the survey and had strong intentions not to smoke in future. "Advanced experimenters" had smoked a whole cigarette more than 30 days before the survey and had weak intentions not to smoke in future or had smoked in the past 30 days but had not 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." Current smoking was defined by the traditional measure of having smoked in the past 30 days.



Survey sampling strategy

Home smoking restrictions were defined by responses to the question: "how is cigarette smoking handled in your home?" with response options being 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 or no school ban) and whether a school ban was strong (most or all students comply) or weak (a ban exists but few or no students comply, or no ban).

Based on school identifiers, we added information on state, county, and city laws relating to restrictions on smoking 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 databases maintained by the American Nonsmokers Rights

Table 1 Characteristics of respondents

	No (%)
Grade at school:	
9	3 912 (25.5)
10	4 357 (28.4)
11	3 835 (25.0)
12	3 252 (21.2)
Sex:	
Male	7 134 (46.5)
Female	8 207 (53.5)
Race or ethnicity:	
White	7 226 (47.1)
African American	3 084 (20.1)
Hispanic	3 590 (23.4)
Other	1 457 (9.5)
Restrictions in public places:	
Strong restrictions	8 760 (57.1)
Moderate restrictions	2 899 (18.9)
Weak restrictions	3 682 (24.0)
Restrictions at home:	
Total ban	7 394 (48.2)
Some restrictions	4 173 (27.2)
No restrictions	3 774 (24.6)
School ban:	
Ban exists	14 083 (91.8)
Ban does not exist	1 258 (8.2)
School ban enforcement:	
Strong ban	4 342 (28.3)
Weak or no enforcement of ban	10 999 (71.7)
Stage of smoking uptake:	
Non-susceptible non-smoker	3 954 (26.4)
Susceptible non-smoker	1 902 (12.7)
Early experimenter	2 876 (19.2)
Advanced experimenter	3 235 (21.6)
Established smoker	3 010 (20.1)

Foundation in California. When county or city laws were stronger than state laws, these took precedence. We defined "strong public places restrictions" as restrictions in private worksites and restaurants, "moderate public places restrictions" as restrictions in private worksites or restaurants, and "weak public places restrictions" as neither of these environments.

Statistical analysis

We analysed data using SAS version 6.12 and MIXOR/MIXREG.[16] We initially used cumulative logit analysis to examine the relation 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. Each analysis was adjusted for school grade, sex, whether adults at home were smokers, and whether siblings smoked. Because of the multistage sampling method we ran random effects intercepts models for each analysis to adjust our standard errors to account for the clustering. Finally, we ran a series of models that made varying assumptions about missing cases. None of these changed the pattern of findings, which indicates that there was no bias in the pattern of missing cases.[18] The final number of cases for the smoking uptake analysis was 14 977 and for the smoking prevalence analysis 14 746.

Results

Table 1 shows the characteristics of respondents and the prevalence of smoking restrictions. In addition, 28% of teenagers (14 746) had smoked in the past 30 days. Concordance between students in their description of the status of the policy at their school was high, with 50% of schools having at least 95% agreement and over 80% having at least 85% agreement.

Table 2 shows that smoking restrictions in public places and at home and enforced school bans were significantly associated with being in an earlier stage of smoking uptake. The relation between stage of smoking uptake and extent of restrictions on smoking in public places varied by stage. 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 the transition from early to advanced experimenter by 8% and of making the transition from advanced experimenter to established smoker by 10%. Thus, more extensive restrictions on smoking in public places were associated with a lower probability of smoking uptake, but this was mostly due to reductions in the probability of transition between later, rather than earlier, stages of uptake. Home smoking restrictions had a much greater effect than bans in public places on uptake of smoking. Total bans on smoking at home exerted a relatively greater impact on transition between earlier, rather than later, stages of smoking uptake but significantly reduced the probability of transition at all thresholds. The existence of some home restrictions also reduced the likelihood of smoking uptake, but the effect was less than for total home bans, being 17% at each threshold. The existence of a ban on smoking at school was not associated with smoking uptake until the last threshold, where it was found to increase the

Table 2 Odds ratios (95% confidence intervals) for association of restrictions with stages of smoking uptake. Odds ratios are not making comparisons with baseline level (non-susceptible non-smokers) but with previous level of smoking stage

	Susceptible non-smoker threshold (95% C)l	Early experimenter threshold (95% CI)	Advanced experimenter threshold (95% CI)	Established smoker threshold (95% CI)
Public place restrictions	0.96 (0.86 to 1.06)	0.93 (0.84 to 1.02)	0.92*† (0.83 to 1.00)	0.90*† (0.81 to 0.98)
Total home ban	0.64* (0.52 to 0.76)	0.69*† (0.59 to 0.79)	0.71*† (0.60 to 0.82)	0.78*† (0.67 to 0.90)
Some home restrictions	0.83* (0.74 to 0.92)	0.83* (0.74 to 0.92)	0.83* (0.74 to 0.92)	0.83* (0.74 to 0.92)
School ban	0.92 (0.77 to 1.08)	0.98 (0.85 to 1.10)	1.07 (0.93 to 1.21)	1.22*† (1.07 to 1.37)
Enforced school ban	0.89* (0.85 to 0.99)	0.89* (0.85 to 0.99)	0.89* (0.85 to 0.99)	0.89* (0.85 to 0.99)

2logL=35 559.3 (df=57), intracluster correlation=0.042, cluster variance =0.143, P<0.0001.
Odds ratios are adjusted for school grade, sex, race, adult smokers in home, and sibling smokers; n=14 977.
*Odds ratio significantly different from 1.0 (P<0.05).
†Odds ratio significantly different from odds ratio at first threshold (P<0.05).

Table 3 Logistic regression analysis for association of restrictions with 30 day smoking prevalence

	Odds ratio (95% CI)	P value
Public place restrictions	0.91 (0.83 to 0.99)	0.03
Total home ban	0.79 (0.67 to 0.91)	<0.001
Some home restrictions	0.85 (0.74 to 0.95)	<0.01
School ban	0.99 (0.85 to 1.13)	0.86
Enforced school ban	0.86 (0.77 to 0.94)	<0.001

2logL=16 271.0, (df=16), intracluster correlation=0.038, cluster variance=0.131, P<0.0001.
Odds ratios are adjusted for school grade, sex, race, adult smokers in home, and sibling smokers; n=14 746.

likelihood of transition from advanced experimenter to established smoker. However, enforced school bans were associated with 11% reductions in uptake of smoking across all stages of uptake.

Table 3 shows that stronger public places restrictions had a significantly protective effect on smoking prevalence, and that home smoking restrictions had a stronger protective effect. The existence of a school ban had no effect, but strong school bans were associated with reduced smoking prevalence.

For each of the analyses, we found no significant interactions between parental smoking and home bans, or between bans in different environments, on the smoking outcome variables.

Discussion

Our study of the relation between smoking restrictions in a range of environments and smoking behaviour of teenagers suggests that restrictions in the home and public places and enforced bans in schools have a protective effect on teenage smoking. These findings are subject to at least four limitations. Firstly, our 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 apart from restrictions on smoking, and these could lead to an artificial relation 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 favourable and there may be other policy influences that promote lower smoking rates by teenagers. We have not controlled for such factors. However, we did control for adult smoking, which is also likely to be influenced by these policies, and found little change in the model variables and no interactions with adult smoking. Nevertheless, our findings require further examination in longitudinal studies.

Secondly, we used a previously untested three point measure for extensiveness of public places laws. Preliminary analyses with a five point scale developed in the 1980s[8 19] produced a similar pattern of findings, although we were concerned about using the older scale because it produced a ceiling effect, with most cases lying in the strongest possible level. Our three point measure better captured the progress that has been made over the past decade in implementing restrictions on smoking in public places.

Thirdly, 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.[20–23]

Notwithstanding these cautions, our finding that home smoking bans reduce smoking uptake and prevalence is consistent with other research. Studies in Europe and the United States have shown that parental opposition to smoking and setting clear standards about smoking are more important predictors of teenagers' intentions to smoke than is parental smoking behaviour.[24–26] 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, banning smoking in the home may reduce the likelihood of teenagers taking up smoking. By comparison, stronger restrictions in public places are likely to have a more modest effect.

Finally, school bans had a protective effect on teenage smoking only when they were strongly enforced. This is generally consistent with the literature and highlights the importance of enforcing smoke-free policies in schools.[11–13]

What is already known on this topic

Restrictions on smoking at home and in public places reduce levels of smoking in adults

Such restrictions are becoming more common

What this study adds

Transition of teenagers through stages of taking up smoking was reduced by bans on anyone smoking at home and also by restrictions on home smoking

Bans in public places also reduced smoking uptake but had less effect than home bans

Smoking bans in schools had little effect unless strongly enforced

Contributors: MAW conceived of and supervised the analysis and led the writing of the paper. FJC helped conceive the study and analyse the data and participated in writing the paper. NJK, CTO, and DCB planned and supervised the survey and participated in writing the paper. EER analysed the data and participated in writing the paper. Don Hedeker provided statistical advice. MAW is the study guarantor.

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Competing interests: None declared.

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Effect of counselling mothers on their children's exposure to environmental tobacco smoke: randomised controlled trial

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Abstract

Objective To test the efficacy of behavioural counselling for smoking mothers in reducing young children's exposure to environmental tobacco smoke.
Design Randomised double blind controlled trial.
Setting Low income homes in San Diego county, California.
Participants 108 ethnically diverse mothers who exposed their children (aged <4 years) to tobacco smoke in the home.
Intervention Mothers were given seven counselling sessions over three months.
Main outcome measures Children's reported exposure to environmental tobacco smoke from mothers in the home and from all sources; children's cotinine concentrations in urine.
Results Mothers' reports of children's exposure to their smoke in the home declined in the counselled group from 27.30 cigarettes/week at baseline, to 4.47 at three months, to 3.66 at 12 months and in the controls from 24.56, to 12.08, to 8.38. The differences between the groups by time were significant ($P=0.002$). Reported exposure to smoke from all sources showed similar declines, with significant differences between groups by time ($P=0.008$). At 12 months, the reported exposure in the counselled group was 41.2% that of controls for mothers' smoke (95% confidence interval 34.2% to 48.3%) and was 45.7% (38.4% to 53.0%) that of controls for all sources of smoke. Children's mean urine cotinine concentrations decreased slightly in the counselled group from 10.93 ng/ml at baseline to 10.47 ng/ml at 12 months but increased in the controls from 9.43 ng/ml to 17.47 ng/ml (differences between groups by time $P=0.008$). At 12 months the cotinine concentration in the counselled group was 55.6% (48.2% to 63.0%) that of controls.
Conclusions Counselling was effective in reducing children's exposure to environmental tobacco smoke. Similar counselling in medical and social services might protect millions of children from environmental tobacco smoke in their homes.

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Introduction

The World Health Organization has estimated that the health of almost half of the world's children is threatened by exposure to environmental tobacco smoke.[1] In the United States the prevalence of US children living in homes with a smoker has been estimated to be 43%, with state specific estimates of exposure in