A Simulation of the Effects of Youth Initiation Policies on Overall Cigarette Use

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A B S T R A C T

Objectives. We developed a simulation model to predict the effects of policies aimed at reducing smoking initiation by youths younger than 18 years.

Methods. The model projected the number of smokers, never smokers, and ex-smokers by age, sex, and racial/ethnic group and the effects of reductions in youth initiation.

Results. The model predicted that even if tobacco policies eliminated youth initiation, the number of smokers would not be halved for more than 30 years. If initiation were halved and some of the initiation were delayed rather than eliminated, substantially smaller reductions would result.

Conclusions. Policies that increase cessation rates are needed to reduce the number of current smokers and the more near-term health problems. (*Am J Public Health.* 2000;90:1311–1314)

Recent policies to reduce tobacco use, such as limiting retail sales, developing school-based education programs, and using counteradvertising campaigns, have focused on youths. These policies are justified by the high rate of smoking initiation before 18 years of age.[1] Individuals who begin to smoke at an early age are also more likely to become addicted to nicotine and have more adverse long-term health effects.[1]

To evaluate the overall effect of youth-related policies, it is useful to know their effect on current and future smoking rates. Health needs can be better assessed thereby, and the various policies aimed at different age groups may be better coordinated. Glantz[2] recently argued that youth-related policies have limited effects and that we need to focus on older smokers.

In this report, we develop a model to predict the number of future tobacco smokers and to consider the effects of policies aimed at reducing initiation. The model was programmed to examine policies aimed at reduced initiation by people younger than 18 years.

Methods

Model

The forecasting model begins with the numbers of smokers, never smokers, and ex-smokers at each age in a baseline year and projects these populations forward. The model uses 1993 as a baseline because data was available for that year**.**

The smoking model is built on a population model that incorporates birth and death. The population is differentiated by time pe-

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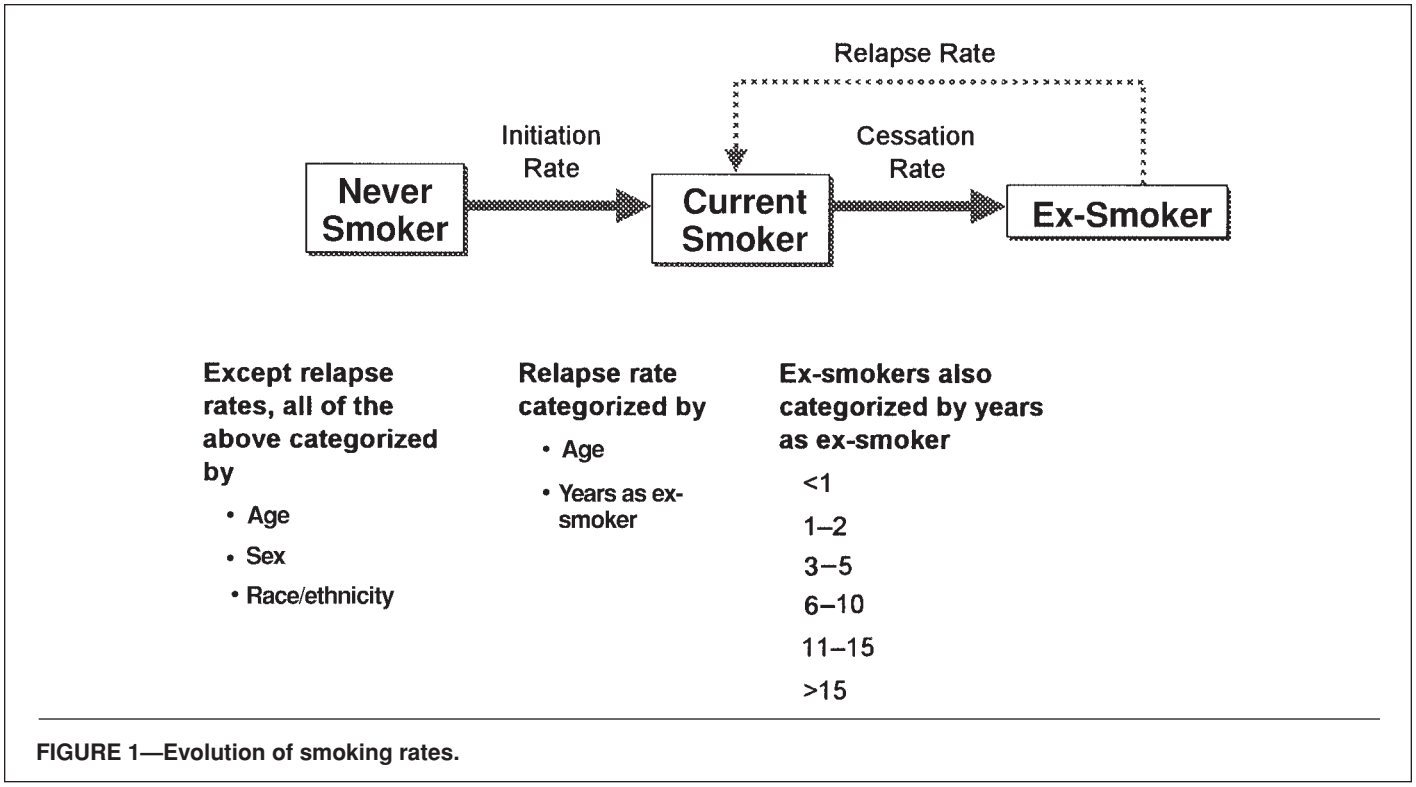

FIGURE 1—Evolution of smoking rates.

riod, age, sex, and racial/ethnic group (White non-Hispanic, Black non-Hispanic, Hispanic, Asian, and other). The number of newborns depends on the fertility rate of females and the fatality rate of newborns in the first year. The model assumes equal birth rates for males and females. After the birth year, population by demographic group each year equals that cohort's population, minus deaths, in the previous year.

Population at any point is divided into current smokers, never smokers, and ex-smokers. A smoker is defined as an individual who has smoked more than 100 cigarettes in his or her lifetime and who smoked at least some days in the past 30 days. The model categorizes ex-smokers by number of years since quitting: <1, 1–2, 3–5, 6–10, 11–15, and >15 years.

As indicated in Figure 1, the numbers of smokers, never smokers, and ex-smokers evolve over time on the basis of initiation, cessation, and relapse rates. Individuals are classified as never smokers from birth until they initiate smoking or die. Because smokers generally initiate smoking before 25 years of age,[3] in the model initiation occurs until that age. Because of difficulties in measuring initiation and quitting, initiation rates are measured without distinguishing quitting.

The number of smokers by age, sex, and racial/ethnic group is tracked as (previous-year smokers − current-year deaths) × (1 + initiation rate). Once an individual begins to smoke, he or she continues as a smoker until he or she quits, dies, or reenters the group through relapse. After 24 years of age, smokers are tracked as (previous-year smokers − deaths) × (1 − first-year cessation rate). Relapsed smokers for each of the ex-smoker categories are also added to smokers. Ex-smokers are tracked separately by group, with relapses taken into account.

A series of Microsoft Excel (Microsoft Corp, Redmond, Wash) spreadsheets were used to track the number of smokers from 1993 to 2043. The effect of youth initiation policies was determined by comparing the smoking rate in the absence of policy with the smoking rate after changing the initiation rate for those younger than 18 years. The precise equations are available from the authors on request.

Data

Population data were obtained from the 1993 census, and fertility rates were from the Bureau of the Census Vital Rate Inputs Tables. Mortality rates were from the 1993 Multiple Cause-of-Death File[4] compiled from death certificates by the National Center for Health Statistics. Death rates of smokers, nonsmokers, and ex-smokers were based on relative risks.[5,6]

The primary source of data on smoking habits is the Tobacco Use Supplement of the Bureau of the Census Current Population Survey,[7] a sample of 293 543 individual respondents from September 1992, January 1993, and May 1993. Because the Tobacco Use Supplement questions pertain only to those older than 14 years, rates for 10 through 14 years of age were calculated with the 1993 Teenage Attitudes and Practices Survey,[8] a supplement to the 1993 National Health Interview Survey of more than 15 000 youths aged 10 to 22 years. Because the Teenage Attitudes and Practices Survey yielded higher rates, it was adjusted on the basis of the relative difference in mean smoking rates for the overlapping 15- to 19-year age groups. Initiation rates were measured as the difference in the smoking rate between those at a particular age and those at the previous age divided by the percentage of previous-year never smokers.

Cessation rates were calculated for those older than 24 years with the Tobacco Use Supplement data. A person was defined as having quit smoking if he or she smoked regularly 1 year ago but does not smoke now and has not smoked for at least 30 days. Because of small sample sizes for some demographic categories, a multiple logistic regression model was estimated that categorized by age, sex, and racial/ethnic group. The rates were then adjusted for first-year relapse.

Relapse was defined as the percentage of people who now smoke after having reported quitting. Because the Current Population Survey did not have the necessary information, we primarily used the Community Intervention Trial for Smoking Cessation (COMMIT)[9] data in consultation with prior studies.[10,11] Relapse rates are in terms of those who quit for at least 30 days. A logistic regression was estimated that categorized by age and length of time since quitting.

TABLE 1—Effects of Initiation Policies on Number of Smokers and Smoking Rates

	1993	1998	2003	2013	2023	2033	2043
Status quo							
No. of smokers[a]	48.1	48.7	47.8	46.4	43.6	41.5	41.4
% of smokers	19.0	18.7	17.6	16.6	15.7	15.1	15.0
50% reduction							
No. of smokers[a]	48.1	46.6	44.1	40.0	35.5	31.6	29.5
% of smokers	19.0	17.7	16.4	14.2	12.5	11.2	10.7
100% reduction							
No. of smokers[a]	48.1	45.0	40.5	33.6	25.9	20.2	16.5
% of smokers	19.0	17.0	15.0	11.6	9.0	7.0	5.9
100% reduction + 25% delayed initiation							
No. of smokers[a]	48.1	45.2	42.5	36.8	30.7	25.9	22.9
% of smokers	19.0	17.4	15.7	13.4	10.7	8.9	8.0

[a]In millions.

Results

Table 1 presents smokers as a percentage of the population (all ages) projected from 1993 to 2043.

Status Quo

Status quo rates are projected with the assumption that initiation, cessation, and relapse rates (and public policies affecting those rates) remain at their baseline level. The smoking rate begins at 19.0% of the total population (all ages from 0 to death) in 1993 and is projected to gradually decrease. By the year 2043, smoking rates are projected to be 15.0% of the total population. The number of smokers declines from 48.1 million in 1993 to 41.4 million in 2043 as the population increases from 256.5 million to 288.5 million.

The reduction in smokers over time results from the lower initiation and the higher cessation rates in 1993 than in earlier cohorts of smokers (e.g., those who started in the 1950s and 1960s). For 1993, the smoking rate at 11 years of age was 0.02%. The smoking rate of that cohort increased to 21.0% by 17 years of age and peaked at 34.0% at 23 years of age. Rates declined slowly to 20.1% by 40 years of age, when much of the cessation occurred. Smoking rates were 12.6% by 60 and 8.3% by 70 years of age, when smokers were largely affected by their higher death rate.

50% Reduced Initiation

The first policy scenario examined the effects of policies that reduce initiation by 50% for those younger than 18 starting in 1993. This policy leads to a 16.4% smoking rate (44.1 million smokers) by the year 2003, compared with 17.6% (47.8 million smokers) in the absence of the policy. After 20 years (the year 2013), there would be 40.0 million smokers, or a 14.2% smoking rate. Even after 50 years (the year 2043), there would be 29.5 million smokers, or a 10.7% smoking rate. The smoking rate and the number of smokers would be about 30% lower than if there were no reduction in initiation after 50 years.

100% Reduced Initiation

Complete elimination of initiation by those younger than 18 years starting in 1993 leads to a reduction in the smoking rate to 15.0% by the year 2003, or 40.5 million smokers. The smoking rate falls to 11.6% after 20 years and to 5.9% after 50 years, or 39% of that without any reduction in initiation. The rate of smoking would not be halved until about 2028, 35 years into the future.

100% Reduced Initiation With Delayed Initiation

Youth access policies may affect the smoking rates of persons older than the legal purchasing age. Some who would have started smoking at a younger age if it were legal to purchase cigarettes may begin to smoke once it is legal. Delayed initiation would offset some of the reduced initiation by those younger than 18. We assumed that initiation before 18 years of age is eliminated but that 25% of those who would have smoked begin at 18. The smoking rate after 10 years would then be 15.7% compared with 15.0% without the offset. By the year 2043, the smoking rate would be 8.0% with delayed initiation, which is about 36% higher than without the offset.

Discussion

The model predicted that even if youth tobacco policies eliminated initiation by those younger than 18 years and none of those persons prevented from smoking began to smoke after 18 years of age, there would still be only modest reductions in the number of smokers over the next 10 years. It would take about 35 years before the number of smokers were halved. With a 50% reduction in youth initiation, the number of smokers would be reduced by only about 30%, even after 50 years.

At least some of the smokers discouraged from smoking before 18 years of age are likely to start smoking at a later age, as evidenced by recent increases in college-age smokers.[12]

Access to tobacco increases at 18 years of age, and tobacco manufacturers would have strong incentives to target promotions to those who are legally able to purchase tobacco. The model indicates that delayed initiation would lead to a substantial increase in the number of future smokers, further eroding the effect of youth initiation policies.

Other studies[13,14] have predicted larger reductions in smoking rates in the absence of reduced youth initiation. Our model used the more recent 1993 as a baseline year for calculating initiation, cessation, and relapse rates. In addition, our model allowed for differences in sex and racial/ethnic group. The model allowed for differences in fertility rates among racial/ethnic groups but did not take into account changes in racial/ethnic composition through immigration and any differences in the smoking rates of immigrants.

In conclusion, even if youth initiation were eliminated and initiation not delayed, the smoking rate would change little in the near term. Even under the most optimistic assumptions, the effect would not be large for decades. Furthermore, smoking-attributable deaths and the health problems from current initiation of smoking are largely experienced 30 to 40 years in the future, so that effects on health would be even more delayed. Efforts to reduce tobacco use among adults are likely to have a more immediate payoff in reduced morbidity and mortality than a policy that is focused largely on youth prevention. □

Contributors

D.T. Levy developed the model and wrote the paper. K.M. Cummings suggested the idea for the paper and contributed to the writing of the paper. A. Hyland helped to shape the analysis and contributed to the writing of the paper.

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