ARTICLE

Predictors of Change on the Smoking Uptake Continuum Among Adolescents

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Context: Understanding how advertising and other risk and demographic factors affect adolescent susceptibility to smoking would allow for the development of more effective youth-targeted tobacco prevention and cessation programs and policies.

Objective: To examine the effect of various demographic and risk factors on different stages of smoking among adolescents.

Design: A nationally representative cross-sectional survey, The Robert Wood Johnson Foundation's Survey of Tobacco Price Sensitivity, Behavior, and Attitudes Among Teenagers and Young Adults.

Subjects: The Robert Wood Johnson Foundation's Survey of Tobacco Price Sensitivity, Behavior, and Attitudes Among Teenagers and Young Adults included 17 287 adolescent respondents (aged, 13-19 years) in 1996.

Main Outcome Measures: Stage of susceptibility and correlates of progression toward regular smoking.

Results: Of all nonsmoking adolescents, 32% were susceptible smokers (have never smoked, but might) with younger adolescents almost 3 times more likely than older adolescents to be susceptible. Female subjects were 54% more likely than male subjects to be susceptible. In addition to exposure to others' smoking, owning or willingness to own tobacco promotional items, having a favorite cigarette advertisement, skipping school, poor school performance, and lack of attendance in religious activities were associated with progression along the uptake continuum.

Conclusions: Improved understanding of the tobacco use trajectories of adolescents and the risk factors associated with progression will help clinicians and tobacco control advocates create effective youth-targeted interventions and policies. Findings suggest that physicians and other health care providers should redouble their efforts to ask preadolescents and young adults about smoking or the likelihood of their smoking. Nonsmokers should also be advised about the addictive nature of tobacco products and the resulting loss of control that accompanies addiction.

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In 1996, THE TOBACCO industry spent $5.11 billion on cigarette advertising and promotion.[1] The effect of this marketing investment is evident in more favorable attitudes toward smoking and increased smoking that are associated with increased exposure to tobacco advertising.[2,3] This marketing investment makes it nearly impossible for adolescents to avoid exposure to some form of tobacco advertising or promotion. The tobacco industry states that its purpose in tobacco marketing is to maintain brand loyalty and not to encourage adolescent smoking, arguing that susceptibility to cigarette use is chiefly the result of influence by family members and/or peers.[4,5] The documents released as a result of the Minnesota lawsuit and the Master Settlement Agreement between state attorneys general and the tobacco companies confirm that the tobacco industry cultivated the youth market. These documents reflect the tobacco industry's recognition of the 14- to 18-year-old consumers as a growing segment of the smoking population critical to the industry's long-term performance and profitability.[6]

Several studies have indicated the effectiveness of the tobacco industry's marketing strategies. Studies have shown that brand name cigarette use is more concentrated among adolescents,[7] and adolescents who smoke are more adept at identifying tobacco advertising than their nonsmoking peers.[8] Furthermore, regardless of their smoking status, adolescents report that the imagery in cigarette advertisements makes cigarette smoking appear appealing.[9] Exposure to tobacco advertising and promotion not only increases an adolescent's knowledge of cigarettes, but also increases susceptibility to to-

SAMPLE SUBJECTS AND METHODS

The Robert Wood Johnson Foundation's National Survey of Tobacco Price Sensitivity, Behavior, and Attitudes Among Teenagers and Young Adults (RWJF Survey) was administered to a broad cross-section of adolescents in 1996. The sample sizes, respondent selection procedures, and weighting procedures were designed to develop national estimates of smoking behaviors and attitudes.

DESCRIPTION OF DATA SOURCE, SAMPLE SIZE, AND RESPONSE RATE

The RWJF Survey was conducted from March through July 1996. The survey sample was stratified by region, race, ethnicity, and socioeconomic status. Students in grades 9 through 12 were selected based on a multistage sample, with selection probability proportional to the size of the target population in each sampling unit. Respondents completed an anonymous, self-administered questionnaire, administered in schools. The RWJF Survey included 17 287 respondents, ages 13 through 19 years, with 73% of the schools agreeing to be surveyed. In those schools included in the sample, 80% of the students completed the questionnaire. The response rate for this survey was similar to the 1995 National Youth Risk Behavior Survey, for which the school response rate was 70% and the student response rate 86%.[19]

MEASUREMENT OF STAGE OF PROGRESSION TO REGULAR SMOKING

A 7-level variable was constructed to measure progress toward regular smoking (**Figure 1**). Never smokers were defined as persons who had never smoked a cigarette and had never tried or experimented with smoking, even a few puffs. Never smokers were further categorized by susceptibility to smoking uptake.[2,20,21] Susceptibility to smoking uptake was measured by 3 questions: (1) If one of your best friends were to offer you a cigarette, would you smoke it? (2) At any time during the next year do you think you will smoke a cigarette? (3) Do you think you will ever smoke a cigarette in the future? "Not susceptible" never smokers were defined as those who answered "definitely not" to all 3 questions. Any other valid response to either of the 3 questions resulted in a "susceptible" designation. Experimenters were defined as those who had never smoked a whole cigarette but had tried smoking. Persons who had smoked a whole cigarette were categorized by whether they had smoked at least 100 cigarettes in their lifetime and by whether they had smoked on 1 or more days during the last 30 days. Regular smoking was defined as having smoked 100 cigarettes during one's lifetime and having smoked on 1 or more of the 30 days preceding the survey.

MEASUREMENT OF CORRELATES OF PROGRESSION TO REGULAR SMOKING

Eight risk factors shown by previous studies to be predictors of smoking in adolescence were used in this analysis. These factors included measures of (1) smoking in the home, (2) smoking behavior of friends, (3) school rules about smoking, (4) poor school performance, (5) skipping school, (6) lack of attendance in religious activities, (7) whether the respondent had a favorite cigarette advertisement, and (8) the influence of tobacco industry promotions.

Smoking in the household was defined by the question: Besides yourself, does anyone who lives in your

bacco use[3,5,10-12] and the likelihood of experimentation[12,13] and initiation.[12] One estimate suggests that tobacco advertising and promotion accounts for approximately 34% of new experimenters representing about 700 000 adolescents each year.[2] As adult market share declines, due to cessation and death, advertising that draws the attention of adolescents helps to recruit new smokers who will replace the lost adult consumers.

In addition to advertising and the influence of family and peers asserted by the tobacco industry,[5] the school environment and religious activities have also been previously shown to influence smoking behavior. Previous research in school settings has found that an absence of school rules,[14] poor school performance,[15,16] and an absence of attendance were associated with increased smoking among adolescents. Additionally, religious activities have been shown to promote better health behaviors and overall declines in substance abuse among adolescents.[17,18]

Using nationally representative data for high school students in the United States, this study examines the distribution of adolescents among 7 stages of smoking uptake. The analysis also tests whether there exists an association between 8 risk factors (smoking in the home, smoking behavior of friends, school rules about smoking, poor school performance, skipping school, lack of attendance in religious activities, whether the respondent had a favorite cigarette advertisement, and the influence of tobacco industry promotions) and progression along the smoking uptake continuum when controlling for the influence of smoking among family and peers.

RESULTS

AGE, RACE, AND SEX DISTRIBUTION BY STAGE OF SMOKING UPTAKE

Estimates of the percentages of the 1996 US adolescent population in each of 7 stages of progression to regular smoking reveal that among all never smokers, younger adolescents are the most susceptible (**Table 1**). Susceptibility declined with age (**Figure 2**). Among the youngest group (aged, 13-14 years), 40.7% (2.9%) of never smokers were susceptible compared with 26.3% (1.7%) of 17- to 18-year-olds. A greater percentage of white (33.1%) and Hispanic (36.5%) never smokers were susceptible compared with black subjects (26.8%). Female never smokers were also more likely than male never smokers to be susceptible (34.1% vs 29.9%).

In 1996, 8.6% of all adolescents aged 13 through 18 years were experimenters (Table 1). The proportion of

household now smoke cigarettes? Friends' smoking was defined as whether 1 or more of the respondent's 4 best male and 4 best female friends smoked. These variables were combined to create a 4-level variable measuring exposure to smoking. A dichotomous school rule about smoking risk factor was defined by the questions: Is there a rule at your school that students are not allowed to smoke anywhere on school property? How many students who smoke obey that rule? Responses indicating no rule, a missing response, or that there is a rule but none or only a few obey the rule were combined. Self-reported school performance was defined as a risk for smoking uptake if the response was "average," "below average," or "do not know" to the question: How do you do in school? The variable skipping school was rated equal to 1 if the respondent skipped or cut 1 or more days of school during the last 4 weeks. School performance and skipping school were combined to create a 4-level variable. A religous attendance risk factor was set equal to 1 if the respondent reported that in the past year, he or she had gone to church, synagogue, or some other type of religious service "never" or "only a few times in the last year." Respondents were asked whether they have a favorite cigarette advertisement, and if they ever received or owned a cigarette promotional item and will ever use a promotional item if offered. These questions were also used on the 1993 California Tobacco Survey to measure receptivity to tobacco marketing.[5] For the favorite cigarette advertisement question, respondents were asked to check the brand of their favorite advertisement, or the one that gets their attention the most. The favorite advertisement risk factor was set equal to 1 if the respondent checked a brand, and set equal to 0 if he or she checked "none/don't like any ads" or "don't know." The influence of tobacco industry promotions was assessed by the question: Some tobacco companies give away items or coupons for items, such as hats, tee shirts, jackets, caps, or other gear. Have you ever received or owned such items from a tobacco company? The tobacco industry promotions risk factor was set equal to 1 if the respondent had received or owned promotional items or would ever use a tobacco industry promotional item, and 0 otherwise. These advertising variables were combined to yield a 4-level variable.

STATISTICAL ANALYSIS

The RWJF Survey responses were weighted before computing estimates of smoking stage. The weights included the probability of selection, an adjustment for nonresponse, and a poststratification ratio adjustment to make the demographic distribution of the samples approximately equal to the distribution of the US population. Our analyses included only respondents aged 13 to 18 years and was restricted to respondents with valid data (nonmissing) for age, race, and sex.

Three logistic regression models were estimated to examine which variables were associated with the 3 different stages of smoking uptake. The independent variables, which are identical for each model, were chosen based on the existing literature and exploratory bivariate analyses. Since the goal of the models was to examine the independent association between each variable while adjusting for other variables previously shown to be associated with the outcome, even those variables that were not statistically significant remained in each model. Data were analyzed using SAS and SUDAAN software to compute point estimates and SEs, respectively.[22,23] All values are reported as proportions (SE).

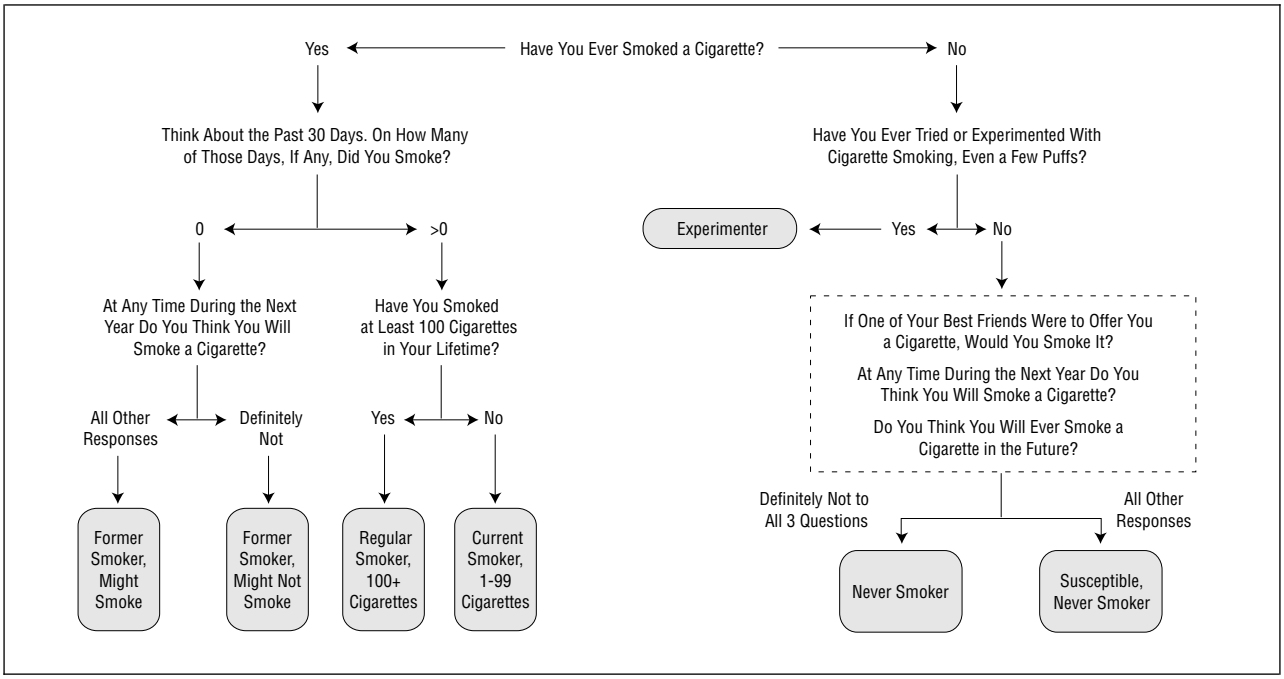

Figure 1. Definitions of 7 stages of smoking uptake.

Table 1. Percentage Distribution of 7 Stages of Smoking, 1996*

Demographic Category	No. of Adolescents	Adolescents Who Never Smoked a Cigarette: Not Susceptible	Adolescents Who Never Smoked a Cigarette: Susceptible	Adolescent Experimenters	Adolescents Who Did Not Smoke a Cigarette in the Past 30 Days: Not Intending to Smoke in the Next Year	Adolescents Who Did Not Smoke a Cigarette in the Past 30 Days: Might Smoke in the Next Year	Adolescents Who Smoked a Cigarette in Past 30 Days: Adolescents Who Smoked 1-99 Cigarettes	Adolescents Who Smoked a Cigarette in Past 30 Days: Adolescents Who Smoked ≥100 Cigarettes
Total No.	**15 036**	21.8 (0.80)	10.3 (0.43)	8.6 (0.26)	12.6 (0.34)	15.1 (0.41)	10.6 (0.29)	21.0 (0.72)
Age, y								
13-14	1057	23.2 (1.91)	16.1 (1.32)	8.4 (0.94)	10.8 (1.13)	17.0 (1.35)	11.6 (1.21)	13.2 (1.25)
15-16	8037	22.4 (1.02)	11.8 (0.49)	8.4 (0.36)	12.1 (0.43)	15.8 (0.53)	11.1 (0.41)	18.4 (0.83)
17-18	5942	20.8 (0.80)	7.4 (0.57)	8.9 (0.51)	13.7 (0.52)	13.8 (0.55)	9.8 (0.46)	25.6 (1.00)
Race								
White	7082	20.4 (1.04)	10.1 (0.57)	6.9 (0.29)	11.3 (0.38)	14.9 (0.51)	9.9 (0.39)	26.5 (0.89)
Black	2911	28.8 (1.42)	10.5 (0.83)	14.4 (0.68)	17.1 (0.88)	12.3 (1.07)	11.6 (0.98)	5.3 (0.59)
Hispanic	3457	18.6 (1.11)	10.7 (0.62)	10.2 (0.61)	14.6 (0.74)	19.9 (1.02)	14.0 (0.69)	12.1 (0.86)
Other	1393	24.6 (1.62)	10.4 (0.95)	10.5 (0.91)	12.8 (1.25)	15.4 (1.10)	9.8 (0.88)	16.5 (1.41)

*Results are based on respondents who provided valid responses (nonmissing) for age (ages 13-18 years), sex, and race. Standard errors included to the right of the point estimate. Data are given as proportion (SE). For an explanation of the 7 stages of smoking, see the "Measurement of Stage of Progression to Regular Smoking" subsection of the "Sample Subjects and Methods" section.

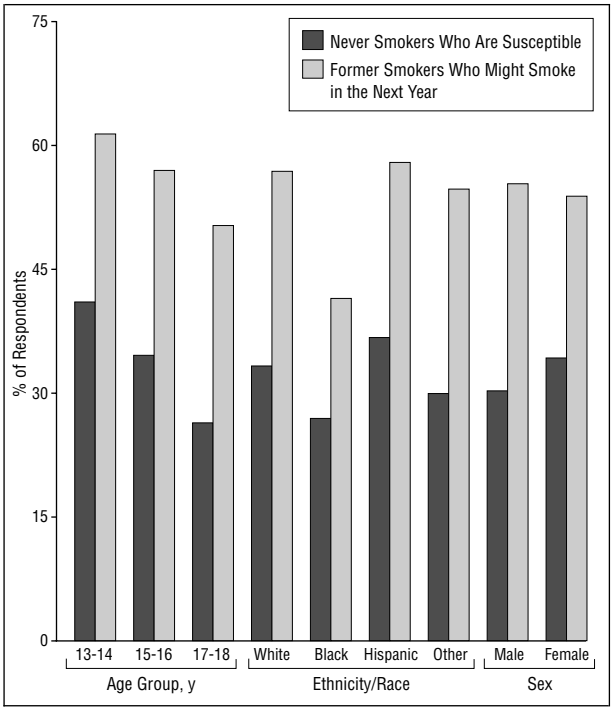

Figure 2. Percentage of all respondents who never smoked who are susceptible and all former smokers who might smoke in the next year.

experimenters was relatively constant across all age groups. A greater percentage of blacks (14.4%) were experimenters than any other racial group.

Among former smokers (those who had smoked previously but not in the past 30 days), more than half reported that they might smoke in the next year. This was highest among 13- to 14-year-olds (60.0%) and declined with age to 50.3% (1.3%) among 17- to 18-year-olds. The propensity to reinitiate smoking varied by racial or ethnic background of the respondent, with blacks the least likely and whites being the most likely (Figure 2).

The proportion of regular smokers varied inversely with age. While 13.2% of 13- to 14-year-olds were regular smokers, one quarter of 17- to 18-year-olds were regular smokers. The greatest proportion of regular smokers was among white adolescents (25.6%), more than 14 percentage points greater than the next highest group (Hispanics, 12.1%)

Sex differences were examined by stage of smoking uptake. Except for greater susceptibility among female never smokers (Figure 2), there were no differences between male and female respondents in any of the other levels of smoking uptake.

PREDICTORS OF 3 STAGES OF SMOKING

Logistic regression was used to examine the influence of various risk factors on probabilities of being in each of 3 distinct stages of progression to regular smoking—susceptible never smoker, experimenter, and regular smoker. Older adolescents were less likely than the youngest (13- and 14-year-olds) to be susceptible but more likely to be experimenters or regular smokers (**Table 2**). Nonwhites were more likely to be experimenters, but significantly less likely to be regular smokers.

Apart from demographics, various risk factors were also associated with smoking uptake. Exposure to friends' smoking and exposure to both family's and friends' smoking were significantly associated with being a susceptible, an experimenter, and a regular smoker. The strongest association was among regular smokers for whom both friends' smoking and family's and friends' smoking were significant.

Skipping school and performing poorly in school were both significantly associated with the likelihood of being an experimenter and a regular smoker. The lack of attendance in religious activities was only significantly associated with regular smoking. There was no association between the presence or the enforcement of school no smoking policies on smoking and uptake.

All levels of receptivity to advertising were significantly associated with being a susceptible never smoker. The same was seen for the other 2 categories of smoking, except being an experimenter was not significantly

Table 2. Risk Factors and Associated Adjusted Odds Ratios for 3 Stages of Smoking Among Adolescents, 1996*

Risk Factors	Susceptible Never Smoker†	Experimenter‡	Smoked 100 Cigarettes and Smoked in Past 30 Days§
Age, y			
13-14	1.00	1.00	1.00
15-16	0.76 (0.54-1.05)	1.26 (0.78-2.04)	1.35 (1.04-1.76)
17-18	0.50 (0.34-0.73)	1.46 (0.90-2.36)	1.88 (1.40-2.54)
Race			
Black	0.78 (0.55-1.11)	1.88 (1.46-2.41)	0.19 (0.14-0.25)
Hispanic	0.98 (0.74-1.32)	1.43 (1.08-1.89)	0.34 (0.28-0.41)
Others	0.98 (0.68-1.34)	1.34 (1.02-1.78)	0.58 (0.46-0.73)
White	1.00	1.00	1.00
Sex			
Female	1.50 (1.22-1.83)	1.09 (0.89-1.34)	1.02 (0.86-1.20)
Male	1.00	1.00	1.00
Risk factors			
Exposure to smoking			
Neither at home nor by friends	1.00	1.00	1.00
Smoking in the home only	0.69 (0.47-1.03)	2.00 (1.36-2.93)	4.34 (0.96-19.68)
Smoking by friends only	1.91 (1.50-2.44)	1.72 (1.33-2.23)	26.29 (7.24-95.38)
Smoking in the home and by friends	1.50 (1.10-2.04)	2.38 (1.62-3.50)	47.89 (12.95-177.04)
Skipping school and school performance			
Neither skip school nor perform poorly	1.00	1.00	1.00
Skip school only	1.13 (0.85-1.52)	1.85 (1.32-2.59)	1.84 (1.49-2.27)
Perform poorly only	1.24 (0.97-1.59)	1.41 (1.06-1.87)	1.62 (1.31-1.99)
Skip school and perform poorly	1.11 (0.74-1.65)	2.27 (1.56-3.30)	3.18 (2.61-3.88)
Smoking rules at school			
None or ignored smoking rules	1.18 (0.74-1.88)	0.93 (0.61-1.44)	0.99 (0.68-1.44)
Obeyed school rules	1.00	1.00	1.00
Religious attendance			
None	1.03 (0.85-1.27)	1.21 (0.95-1.54)	1.34 (1.17-1.54)
Regular	1.00	1.00	1.00
Receptivity to advertising			
No favorite advertisement and does not own/use promotional item	1.00	1.00	1.00
Has favorite advertisement only	1.61 (1.19-2.18)	1.60 (1.09-2.36)	1.24 (0.90-1.71)
Owns/would use promotional item only	2.22 (1.55-3.19)	1.10 (0.72-1.69)	2.50 (1.91-3.29)
Has favorite advertisement and own/use promotional item	3.41 (2.54-4.58)	1.96 (1.46-2.62)	3.09 (2.44-3.92)

*Data are given as odds ratios (95% confidence intervals). Each column represents a separate model. Each odds ratio is adjusted for the influence of all other variables included in the model. For an explanation of the 7 stages of smoking, see the "Measurement of Stage of Progression to Regular Smoking" subsection of the "Sample Subjects and Methods" section.

†Odds ratio for being susceptible, never smoking adolescents compared with not susceptible adolescents.

‡Odds ratio for those adolescents who have experimented with smoking compared with all adolescents who never smoked (ie, those who were and were not considered susceptible).

§Odds ratio for those adolescents who smoked 100 or more cigarettes in a lifetime and in the past 30 days compared with those who have smoked in the past 30 days but have not smoked 100 cigarettes in their lifetime; all former smokers, experimenters, and all those who never smoked.

associated with owning an item and being a regular smoker was not associated with having a favorite advertisement.

COMMENT

Several of the findings presented herein have implications for primary care physicians, nurses, and dentists—all of whom have regular contact with adolescents. First, while an adolescent may not be smoking, he or she may be susceptible to smoking. As these data indicate, almost 50% of all adolescents who have never smoked can be defined as susceptible. When interacting with adolescents who do not smoke, physicians may want to consider screening for an adolescent's susceptibility to this behavior. Also, a significant proportion of former smokers report that they may smoke in the next year. This is an opportunity for physicians to support an adolescent's initial cessation and encourage adolescents to not return to this unhealthy behavior.

The tobacco industry has long held that susceptibility to cigarette smoking is the result of family and peer smoking.[4,5] While the data presented indicate that environmental exposures are highly associated with varying stages of smoking uptake, they also identify several other variables that also contribute to smoking uptake. Receptivity to advertising, skipping school, poor self-assessed school performance, and lack of religious attendance were all found to be significantly associated with 1 or more stages of smoking uptake.

Exposure to smokers in the household and among best friends was highly associated with susceptibility to smoking and progression. This information can be used by physicians to engage parents in a discussion about their own quitting. In addition, all parents can be made aware of the influence of peer groups with which their chil-

What This Study Adds

The tobacco industry has alleged that its purpose in advertising is to maintain brand loyalty and not to encourage adolescent smoking, arguing that susceptibility to cigarette use is chiefly the result of influence by family members and/or peers. To test this assertion using a nationally representative data set, this study examined the association between 8 risk factors and progression along the smoking uptake continuum when controlling for family and peer smoking influences.

This analysis shows that several factors including tobacco advertising and promotion, poor school performance, skipping school, and lack of religious attendance are all associated with increased likelihood of being in various stages along the smoking uptake continuum. Improved understanding of the tobacco use trajectories of our young and the risk factors associated with progression will help clinicians and public health advocates create targeted interventions and policies to prevent progression toward more established smoking.

dren become involved and the need to watch for warning signs like skipping school and poor school performance. To assist adolescents who are already smoking, physicians should counsel and assist teen smokers in quitting using methods recommended for adults but modified to be developmentally appropriate,[24] until further research points to more effective programs for adolescent cessation.

Since the proportion of susceptible nonsmokers is highest among 13- and 14-year-olds and declines as age increases, interventions in late childhood and early adolescence should be emphasized. Preventive guidance and assessment of smoking status should be a routine component of every visit for adolescents of all ages, as approximately 8% of adolescents of all ages are experimenters. Since approximately 30% of these experimenters could be expected to become established smokers,[25] we project that 587 000 experimenters aged 13 to 18 years will go on to smoke at least 100 cigarettes. Experimentation is an important part of smoking uptake, and preventive guidance could greatly influence those who persist in smoking and those who cease.

Nonwhite adolescents were significantly more likely to be experimenters, but significantly less likely to be regular smokers. The cross-sectional nature of these data do not allow for assessing why this occurs, but one possibility is that white adolescents may progress more quickly from experimenter to more established smoker.[26] If this is the case, then white adolescents would spend less time in the experimenter phase and a cross-sectional survey would find fewer whites in this stage. Only longitudinal studies can adequately address this question.

These results underscore the need to counter the influence of protobacco messages aimed at or received by younger adolescents. Tobacco control policies are needed to limit the exposure of children and young adolescents to tobacco advertising and promotion, such as print advertisements, counter displays, and promotional signs in or outside of places where tobacco is sold. With the demise of billboard advertisements, it is likely that these other forms of marketing will increase. Tobacco company promotional items and sponsorship of community events and organizations should be monitored for their effects on youth progression. While provisions of the Master Settlement Agreement have restricted the tobacco industry from using some common advertising techniques, in 1999, the first full year following the Master Settlement Agreement, spending on tobacco advertising exceeded $8 billion, a 22.3% increase over 1998 spending levels.[27,28] This marked the largest increase in spending on tobacco advertising since the Federal Trade Commission began tracking advertising expenditures in 1970.[29] Further research is also needed on the long-term effectiveness of countermarketing campaigns, such as those used in Arizona, California, Florida, and Massachusetts.[30,31]

This study offers important insights into stages of smoking trajectories that are useful for clinical and policy interventions. However, the limitations of these analyses must be noted. As with all surveys, there is the potential for bias related to issues of social desirability and recall. Respondents were assured of the anonymity of their responses, which would limit the possible effect of either bias. In addition, this study uses a cross-sectional design, which limits the ability to make causal inferences. For example, it is unclear if skipping school and/or poor school performance preceded smoking or occurred afterward. Therefore, while exposure to friends' smoking is significantly associated with smoking uptake, these data cannot determine if an adolescent began smoking and then became friends with other smokers or if the pathway is reversed. However, for advertising and promotion, longitudinal studies conducted in California and Massachusetts have shown that adolescents who were receptive to tobacco industry promotion at baseline were more likely to have progressed further toward established smoking than nonreceptive adolescents.[2,3] The vast expenditures of the tobacco industry on advertising and promotion ensure that children and adolescents will continue to be exposed to messages that encourage them to smoke. While research in the medical literature has focused on the relationship between receptivity to advertising and smoking uptake, there is a scarcity of information on the differentiating characteristics of those adolescents who are receptive as compared with those who are not. Future research should examine this question to develop interventions to assist adolescents in resisting the lure of advertising and promotion.

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