

Incidence and Predictors of Smokeless Tobacco Use among US Youth

ABSTRACT

Objectives. The purpose of this study was to provide estimates of the cumulative incidence of initiation of smokeless tobacco use in a cohort of young persons and to explore sociodemographic, environmental, behavioral, and personal predictors of experimentation with and regular use of snuff or chewing tobacco.

Methods. The data for this cohort study were derived from the 1989 Teenage Attitudes and Practices Survey and its 1993 follow-up. The study included 7830 young people 11 through 19 years of age at baseline.

Results. During the 4 years, 12.7% of participants (20.9% of male participants) first tried smokeless tobacco, and 4.0% (8.0% of male participants) became self-classified regular users. This suggests that, each year, approximately 824 000 young people in the United States 11 to 19 years of age experiment with smokeless tobacco and about 304 000 become regular users. Cumulative incidence was highest for male non-Hispanic Whites. Predictors of regular use included age, geographic region, cigarette smoking, participation in organized sports, and perceived friends' approval or indifference.

Conclusions. Public health approaches to preventing use of smokeless tobacco should include development of skills for responding to pressures to use tobacco. (*Am J Public Health.* 1998;88:20-26)

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Introduction

The use of smokeless tobacco (snuff and chewing tobacco) can cause oral cancer^{1,2} and nicotine addiction,³ and it has been associated with several oral conditions¹ and increased risk of death from cardiovascular diseases.⁴ Despite attempts to prevent smokeless tobacco use through education, warning labels on packaging, and prohibitions on radio and television advertising,⁵ sales of moist snuff have increased yearly, from 17.2 million lb (7.7 million kg) in 1972 to 53.2 million lb (23.9 million kg) in 1994.⁶

Manufacturers of smokeless tobacco apparently have developed successful marketing strategies that recruit new users with products that deliver low dosages of nicotine.⁷⁻¹¹ Users then "graduate" to higher dosage products as their addiction to nicotine develops. It is likely that a number of personal, social, and environmental factors are involved in the decision to try smokeless tobacco products and in the progression to regular use and nicotine addiction. Some studies have examined concurrent correlates of smokeless tobacco use in young people¹²⁻¹⁸ or longitudinal predictors of use in selected geographic regions,¹⁹⁻²² but no prospective studies have been reported among a US national sample of young people.

The purposes of this study were (1) to estimate cumulative incidence of the start of smokeless tobacco use in a nationally representative cohort of young persons and (2) to identify sociodemographic, environmental, behavioral, and personal factors that may predict experimentation with or regular use of snuff or chewing tobacco.

Methods

Sample

The data for this study were derived from the 1989 Teenage Attitudes and Practices Survey and its 1993 follow-up. These national household-based surveys were sponsored primarily by the Office on Smoking and Health of the Centers for Disease Control and Prevention (CDC). The baseline survey sampling frame consisted of all teenagers 12 to 18 years of age (on November 1, 1989) who resided in households interviewed for the National Health Interview Survey²³ (NHIS) during the last two quarters of 1988 and the first two quarters of 1989 (eligible sample, n = 12 097).²⁴ At baseline, interviewers collected data on knowledge, attitudes, and practices regarding tobacco use by using computer-assisted telephone interviews (n = 9135; response rate = 75%). Persons who could not be contacted by telephone were sent self-administered questionnaires by mail. Of the 9135 respondents to the baseline telephone interview, 7960 (87.1%)

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participated in the follow-up. The primary method of data collection in the follow-up was computer-assisted telephone interviewing; persons who could not be contacted by telephone were contacted in person. The overall response rate for the follow-up was 62% (95% NHIS completion rate \times 75% initial survey completion rate \times 87% follow-up completion rate). Data were ratio adjusted for nonresponse by sex, age, and race and weighted to provide US national estimates, assuming that data were missing at random with respect to outcome and predictor variables. We excluded from the analysis records with incomplete data on smokeless tobacco use or on baseline predictor variables.

Definitions of Outcomes and Predictors

Survey participants were asked whether they had ever tried chewing tobacco or snuff and whether they had ever considered themselves regular users of these products. On the basis of responses to these questions, persons were categorized as having never used smokeless tobacco (never users), having used smokeless tobacco but never regularly (experimenters), or having used smokeless tobacco regularly at some time (regular users). To estimate the cumulative incidence of experimental use, we calculated the proportion of persons who were never users at the baseline survey who became experimenters by the time of the follow-up survey. To estimate the cumulative incidence of regular use, we calculated the proportion of never users and experimenters at baseline who became regular users. We calculated confidence intervals (CIs) for estimated proportions by using logit transformations.²⁵

The selection of potential predictor variables and covariates for experimentation with and regular use of smokeless tobacco was largely guided by previous cross-sectional and prospective studies.¹²⁻²² These variables, measured at the baseline survey, included (1) sociodemographic factors (age, sex, ethnicity, socioeconomic status, geographic region, population density, and number of parents in the household); (2) environmental factors (parental or sibling use of smokeless tobacco, peer use of smokeless tobacco, and perceived social support); (3) behavioral factors (academic performance, cigarette smoking, participation in organized sports, risk taking, physical fighting, steady dating, and attendance at religious services); and (4) personal factors (perceived adverse health effects and perceived approval of friends).

Statistical Methods

The primary measure of association between the predictor variables and the outcome variables was the odds ratio (OR), which we calculated by using logistic regression modeling. To estimate crude odds ratios, we modeled each potential predictor individually for each of the two outcomes. Starting with saturated models, we then constructed parsimonious multivariable logistic regression models for experimentation and regular use. In the initial modeling stage, we retained any independent variable with a univariate Wald test *P* value of less than .25.²⁶ Variables were retained in the final multivariable models if the 95% confidence intervals of their estimated odds ratios for one or more categories excluded unity. We assessed the goodness of fit of the multivariable logistic regression models by using the Hosmer-Lemeshow test.²⁶ We conducted preliminary data analysis using the SAS statistical software package,²⁷ and, because of the complex survey design, we used SUDAAN computer software²⁸ to estimate all standard errors.

Results

After exclusion of records with incomplete data on smokeless tobacco use or on predictor variables (*n* = 130; 1.6%), the sample size in this study was 7830. The sample involved nearly equal numbers of male and female respondents; the baseline age range was 11 through 19 years; and approximately three fourths of the respondents were non-Hispanic Whites (hereafter referred to as Whites).

Cumulative Incidence of Experimentation and Regular Use

Between the time of the baseline survey and the 4-year follow-up, 12.7% of study participants became experimenters, and 4.0% became regular users of smokeless tobacco (Table 1). Among persons who reported, at the baseline survey, that they never had used smokeless tobacco, 1.7% had become regular users by the time of the follow-up (Figure 1). Among those who had tried smokeless tobacco but never had been regular users, 17.9% reported that they had used it regularly by the time of the follow-up survey (Figure 2). Of male adolescents who were never users at baseline, 20.9% became experimenters by the time of the follow-up survey; 8.0% of male respondents who had never regularly used smokeless tobacco became regular users. The

cumulative incidence of experimentation was significantly higher for White male adolescents (26.4%) than for Black or Hispanic male adolescents or those of other or unknown race/ethnicity (7.1%, 15.8%, and 11.8%, respectively). White male respondents also were significantly more likely to become regular users over the 4-year period. Among female respondents, 6.7% became experimenters over this 4-year period, and Whites were more likely than Blacks to try smokeless tobacco. Regular use by female respondents was rare in all ethnic and age groups.

Because the sample design and statistical weighting were intended to permit inferences to the US population of adolescents and young adults, we estimated the annual number of young people in the nation who became experimenters or regular users of smokeless tobacco during the study period. Dividing the 4-year cumulative incidence rates by four to obtain annual estimates, we estimated that 3.2% of young people 11 to 19 years of age tried smokeless tobacco for the first time each year and that 1.0% who had never used it or never used it regularly became regular users after 1 year. According to the US Bureau of the Census, there were approximately 31.39 million persons 11 through 19 years of age on July 1, 1989,²⁹ a date that closely approximated the beginning of data collection in the Teenage Attitudes and Practices Survey. Using baseline estimates from our study, we estimated that 82.7% (25.96 million) of these young people never had used smokeless tobacco. Applying the annual cumulative incidence rate of experimentation to these never users, we estimated that, in the United States, 824 000 young people 11 through 19 years old first used smokeless tobacco each year between 1989 and 1993. In 1989, approximately 96.9% (30.42 million) of young people 11 through 19 years of age never had used smokeless tobacco regularly. Of those, an estimated 304 000 became regular users each year.

Predictors of Experimentation

Because the cumulative incidence of both experimentation and regular use of smokeless tobacco was much higher for White male respondents than for others, and because 89% of incident regular users in this sample were White male adolescents, we limited detailed investigation of predictors to this group. The relatively small number of female respondents and Black or Hispanic male respondents who had tried or regularly used smokeless tobacco precluded separate analyses for these groups.

TABLE 1—Cumulative Incidence of Smokeless Tobacco Use from Baseline to 4-Year Follow-Up, by Sex and Race/Ethnicity: Teenage Attitudes and Practices Surveys, 1989 to 1993

	Experimenters ^a		Regular Users ^b	
	No.	% (95% CI)	No.	% (95% CI)
Male respondents	2769	20.9 (19.2, 22.7)	3721	8.0 (7.0, 9.2)
Race/ethnicity				
White, non-Hispanic	1887	26.4 (24.4, 28.6)	2732	10.4 (9.2, 11.8)
Black, non-Hispanic	475	7.1 (4.8, 10.4)	525	0.8 (0.3, 2.1)
Hispanic	283	15.8 (12.2, 20.3)	322	4.1 (2.2, 7.4)
Other/unknown	124	11.8 (7.7, 17.9)	142	3.8 (1.7, 8.4)
Age, y				
11–14	1518	20.6 (18.5, 22.9)	1749	6.3 (5.1, 7.7)
15–17	974	21.4 (18.7, 24.4)	1475	10.4 (8.8, 12.2)
18–19	277	20.4 (15.9, 25.8)	497	6.9 (4.7, 9.9)
Female respondents	3693	6.7 (5.8, 7.8)	3856	0.3 (0.2, 0.5)
Race/ethnicity				
White, non-Hispanic	2701	7.8 (6.6, 9.1)	2835	0.3 (0.2, 0.6)
Black, non-Hispanic	558	3.3 (2.0, 5.4)	574	0.1 (0.0, 0.8)
Hispanic	303	4.4 (2.4, 8.0)	309	0.0 ...
Other/unknown	131	6.5 (3.6, 11.4)	138	0.0 ...
Age, y				
11–14	1596	5.9 (4.7, 7.4)	1632	0.2 (0.1, 0.6)
15–17	1584	7.1 (5.8, 8.8)	1673	0.3 (0.1, 0.7)
18–19	513	8.1 (6.0, 11.1)	551	0.2 (0.0, 1.5)
Total	6462	12.7 (11.8, 13.7)	7577	4.0 (3.5, 4.6)

Note. Percentages and confidence intervals (CIs) are based on weighted data.

^aPersons who reported at baseline that they never had used smokeless tobacco and reported at follow-up that they had used smokeless tobacco but never regularly.

^bPersons who reported at baseline that they never had used smokeless tobacco ($n = 6462$) or never had used it regularly ($n = 1115$) and who reported at follow-up that they had ever been regular users ($n = 315$).

Bivariate analysis revealed that the rate of experimentation with smokeless tobacco by White male respondents was slightly higher for those who did not live in a metropolitan statistical area (OR = 1.3, 95% CI = 1.0, 1.7). Also, experimentation was somewhat more likely for White male adolescents who did not have two married parents in the household than for those whose parents were married and living in the same household (OR = 1.3, 95% CI = 1.1, 1.7). Perceived use of smokeless tobacco by peers, self-reported intention to use, and perceived approval of or indifference to use by one's best friends were statistically significant predictors of experimentation. Persons who reported that they usually discussed serious problems with a friend were significantly more likely to try smokeless tobacco than those who usually discussed problems with their parents (OR = 1.7, 95% CI = 1.3, 2.3). Respondents who reported at baseline that they liked to engage in risky behaviors, who were current cigarette smokers, who reported involvement in physical fights, who had ever had a steady girlfriend, and who reported truancy from school were significantly more likely to try smokeless tobacco. Belief that smokeless tobacco could cause cancer was not a statis-

tically significant predictor of abstinence from use.

In multivariable modeling, all of the variables significantly associated with experimentation in bivariate modeling remained statistically significant predictors, with the exception of physical fighting in the past year (Table 2). The Hosmer-Lemeshow test statistic indicated acceptable model fit.

Predictors of Regular Use

Bivariate analysis indicated that White male respondents 15 to 17 years of age at the time of the baseline survey were significantly more likely than those 11 to 14 years of age to become regular users of smokeless tobacco over the subsequent 4-year period (OR = 1.7, 95% CI = 1.3, 2.2). Those in the South and Midwest regions of the United States were significantly more likely to become regular users than those living in the Northeast. Use of smokeless tobacco by household members, use by other relatives, and perceived use by peers were statistically significant predictors of regular use. The likelihood of regular use of smokeless tobacco was greater for persons who spent 11 or more hours per week at

home without parental supervision, those with average or below average self-reported school performance, and those who smoked cigarettes at the time of the baseline survey. White male respondents who participated in organized sports or physical activities were more likely than nonparticipants to become regular users of smokeless tobacco. Self-described risk seekers, those who engaged in physical fighting, and those who reported having ever had a steady girlfriend had a higher probability of using smokeless tobacco regularly. White male adolescents who perceived that their friends would approve or not care if they used smokeless tobacco were significantly more likely to become regular users than those who thought that their friends would disapprove (OR = 2.3, 95% CI = 1.7, 2.9).

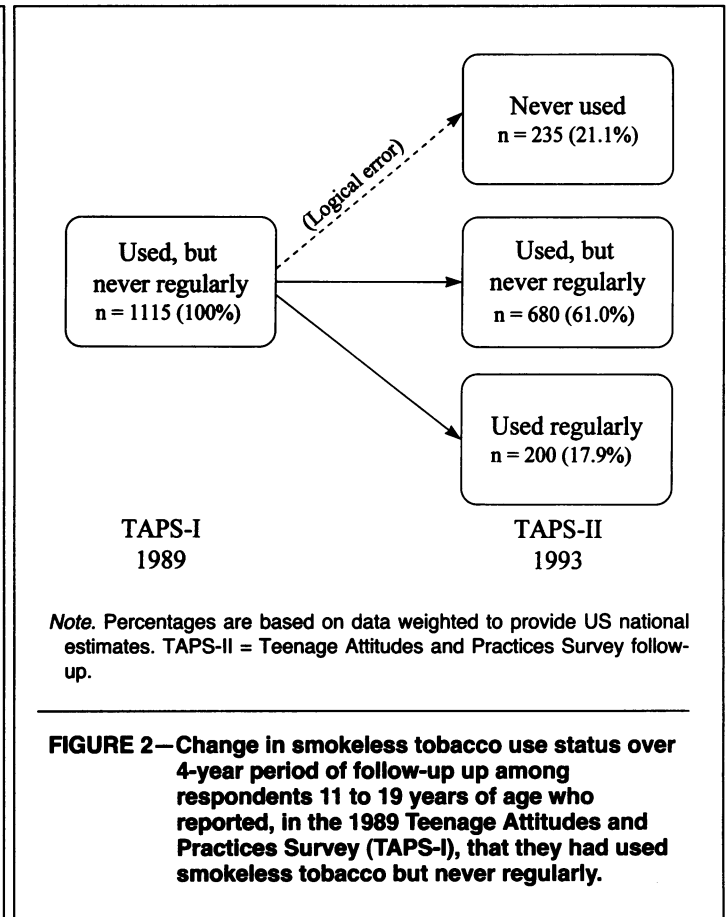
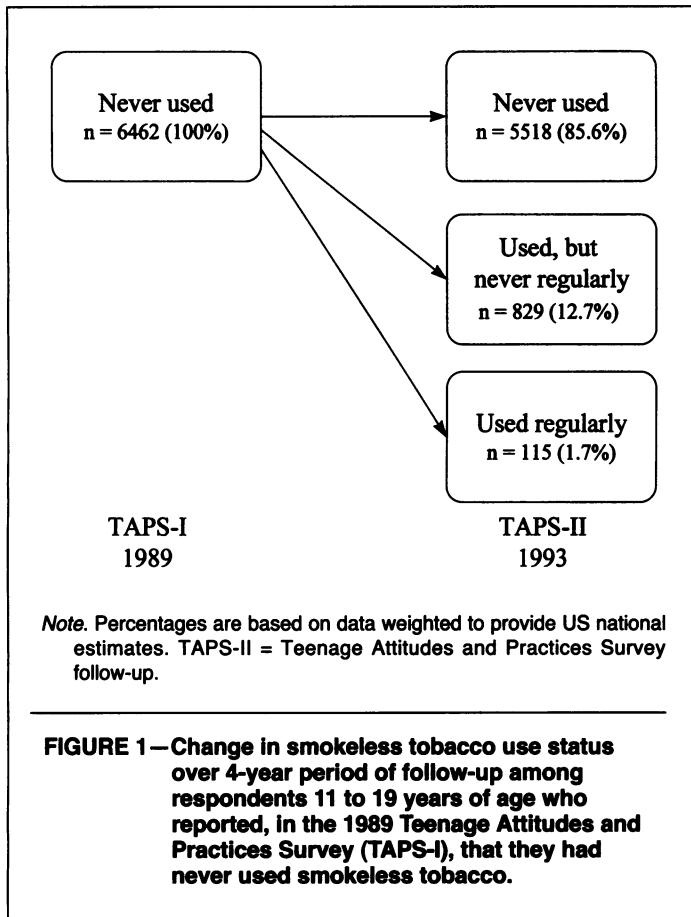
Most significant predictors in the bivariate analysis remained in the multivariable logistic regression model of regular use of smokeless tobacco (Table 2). Significant predictors in the final model for regular use of smokeless tobacco were age at baseline, geographic region, use of smokeless tobacco by a person in the home, perceived use by peers, current cigarette smoking status, participation in organized sports or physical activity, self-described risk seeking behavior, steady girlfriend, and perceived friends' approval of or indifference to smokeless tobacco use. The Hosmer-Lemeshow test statistic indicated acceptable model fit.

Discussion

The results of this study suggest that, each day, more than 2200 young people in the United States first try smokeless tobacco, and about 830 become regular users. This finding may help to explain the annual increase in the sales of moist snuff,⁶ the most popular form of smokeless tobacco among adolescents and young adults in the United States.^{11,30}

This study found that a number of sociodemographic, environmental, behavioral, and personal factors may help predict experimentation with or regular use of smokeless tobacco. Experimentation may be a function of personal factors, coupled with a weak family structure or support. In contrast, progression to regular use appears to be partially a function of adult role modeling, peer influences, and sports team membership.

The sociodemographic predictors of experimentation and regular use of smokeless tobacco in this study are generally consistent with the findings of other studies.^{17,21,31,32} National surveys of youth in the



United States have found a much higher prevalence of smokeless tobacco use among White male adolescents than among female adolescents or those of other racial or ethnic groups,³³ although there have been reports of very high prevalence of use among American Indian and Alaskan Native youth.^{34,35} The geographic differences in the incidence of regular use may reflect differences in cultural and regional norms, as well as regional differences in the marketing of smokeless tobacco products.

Use of smokeless tobacco by persons in the respondents' homes and use by other relatives outside the household were only marginally predictive of experimentation but were significantly predictive of regular use. This pattern suggests that role modeling by parents, siblings, and other relatives may present some increased risk of experimentation, as well as providing a strong reinforcement of the behavior once experimentation has occurred. Several cross-sectional studies have found an association between parental or sibling use and adolescent use of smokeless tobacco,^{12,14-18} but parental use was not a significant predictor in two longitudinal studies.^{19,20}

Peer use of smokeless tobacco was a significant predictor of experimentation or initiation of use among White male adoles-

cents in this study; it was also a strong predictor of regular use. These results are consistent with the findings of numerous cross-sectional investigations.^{14-18,36-39} In one longitudinal study, peer use of smokeless tobacco was related to initiation of adolescent use at a 9-month follow-up¹⁹; in another study, however, it was not related to initiation of use at a 6- or 12-month follow-up.²⁰

Several predictors in this study suggest that family structure or relationships adolescents had with their parents may affect smokeless tobacco use. A living situation other than a two-parent household was found to be associated with smokeless tobacco experimentation or initiation of use; this result is consistent with the findings of several studies.^{21,31} In a study of predictors of smoking, Castro et al. reported that living in a disrupted family system was an initial stressor that apparently predicted social nonconformity and affiliation with cigarette-smoking peers; both of these factors predicted smoking.⁴⁰ A similar mechanism may exist for the initiation of smokeless tobacco use.

White male adolescents who participated in organized athletics were more likely than nonparticipants to become regular users of smokeless tobacco. This finding is in contrast to the pattern of cigarette smoking

among young people; that is, sports participants are less likely than nonparticipants to smoke cigarettes.⁴¹ The increased risk of smokeless tobacco use by young male athletes may be the result of the unfortunate role modeling of its use by professional athletes and manufacturers' marketing of these products at sporting events and through other sports-oriented milieus.^{42,43}

The belief that using smokeless tobacco can cause cancer was held by nearly all (97%) White male adolescents in this study, but it had no significant effect on the likelihood of trying or regularly using smokeless tobacco. This finding underlines the need for public health approaches to preventing smokeless tobacco use that go beyond providing knowledge on the mortal health effects.⁴⁴ Health messages that emphasize only the long-term consequences of using smokeless tobacco are not likely to dissuade a sizable proportion of the adolescent and young adult population.

The increased likelihood of smokeless tobacco use among White male cigarette smokers relative to nonsmokers may indicate that similar factors are involved in the steps of initiating the use of cigarettes and the use of smokeless tobacco.³³ This increased likelihood of use also may be due to nicotine addiction in these young smok-

TABLE 2—Multivariable Logistic Regression Analyses of Selected Factors Associated with Onset of Experimentation with or Regular Use of Smokeless Tobacco from Baseline to 4-Year Follow-Up by Male Non-Hispanic Whites: Teenage Attitudes and Practices Surveys, 1989 to 1993

Predictor	Experimentation, ^a Adjusted OR (95% CI)	Regular Use, ^b Adjusted OR (95% CI)
Age, y		
11–14	...	1.0 (Referent)
15–17	...	1.0 (0.7, 1.4)
18–19	...	0.5 (0.3, 0.9)
Region ^c		
Northeast	...	1.0 (Referent)
Midwest	...	1.6 (1.0, 2.5)
South	...	2.2 (1.4, 3.3)
West	...	1.6 (1.0, 2.6)
Non-MSA resident status ^d	1.4 (1.1, 1.8)	...
Use of smokeless tobacco by person in home	...	2.2 (1.5, 3.0)
Household without two married parents	1.3 (1.0, 1.6)	...
How many people you know, who are about your age, use chewing tobacco or snuff?		
None	1.0 (Referent)	1.0 (Referent)
A few/some	1.3 (1.1, 1.6)	1.6 (1.2, 2.3)
Most/all	1.8 (0.9, 3.6)	2.8 (1.5, 5.1)
Who do you talk to about serious problems?		
Parent	1.0 (Referent)	...
Other adult or relative	1.1 (0.8, 1.4)	...
Friend	1.4 (1.0, 1.8)	...
No one	0.5 (0.2–0.8)	...
Cut school in past 2 weeks	2.0 (1.0, 4.1)	...
Cigarette smoking status		
Never	1.0 (Referent)	1.0 (Referent)
Former	0.6 (0.1, 3.0)	1.2 (0.4, 3.0)
Current	1.7 (1.1, 2.8)	1.9 (1.2, 2.9)
Participation in organized sports	...	1.4 (1.0, 1.9)
Like doing things that are a little risky or dangerous	1.5 (1.2, 1.9)	1.5 (1.1, 2.0)
Ever had steady girlfriend	1.3 (1.0, 1.6)	1.8 (1.2, 2.7)
Think you will ever use chewing tobacco or snuff	2.7 (1.0, 7.4)	...
Perceived approval or indifference of best friends if used chewing tobacco or snuff regularly	1.4 (1.1, 1.7)	1.7 (1.2, 2.2)

Note. The Hosmer-Lemeshow goodness-of-fit test results for the model of experimentation were $C = 10.53$, $df = 8$, $P = .23$; the test results for the model of regular use were $C = 10.68$, $df = 8$, $P = .22$. OR = odds ratio; CI = confidence interval; MSA = metropolitan statistical area. Odds ratio estimates are based on weighted data. Crude odds ratio estimates are available from the authors.

^aPersons who reported at baseline that they never had used smokeless tobacco ($n = 1786$) and reported at follow-up that they had used smokeless tobacco but never regularly ($n = 497$). The analysis excluded 101 respondents who reported at baseline that they never had used smokeless tobacco and reported at follow-up that they had ever been regular users.

^bPersons who reported at baseline that they never had used smokeless tobacco ($n = 1887$) or never had used it regularly ($n = 845$) and who reported at follow-up that they had ever been regular users ($n = 281$).

^cNortheast = Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; Midwest = Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; South = Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; West = Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

^dThe definitions and titles of MSAs are established by the US Office of Management and Budget with the advice of the Federal Committee on Metropolitan Statistical Areas. Generally, an MSA consists of a county or group of counties containing at least one city with a population of 50 000 or more, along with adjacent counties that are metropolitan in character and are economically and socially integrated with the central city.

ers.⁴⁵ Use of smokeless tobacco may provide a supplementation or substitution of nicotine intake for cigarette smokers; this scenario could be particularly true in situations in which smoking is not permitted.

This study has several limitations that should be considered when interpreting its findings. First, all data on the use of smokeless tobacco were based on self-reports from respondents collected by using an interviewer-administered, telephone-based survey. Young people may significantly underreport smokeless tobacco use.⁴⁶ Telephone-based surveys and face-to-face household interviews may compromise respondents' sense of privacy and thus produce lower estimates of current prevalence of substance use among young people than do household or school-based self-administered questionnaires.^{47–49} The net result of these factors may have been an underestimate of the cumulative incidence of smokeless tobacco use and an attenuation of the strength of association between predictors and outcomes.

Bias may have been introduced as a result of differential response rates between tobacco users and nonusers, undermining the assumption of random nonresponse with respect to analytic variables. Analysis of the original Teenage Attitudes and Practices Survey sample by status of smokeless tobacco use at the time of the 1989 interview revealed that youths who were successfully followed up were less likely to have reported smokeless tobacco use than those who could not be reinterviewed (CDC, unpublished data, 1996). Persons who progressed to experimentation with or regular use of smokeless tobacco may have been more likely to be lost to follow-up than those successfully recontacted, which may have led to an underestimation of cumulative incidence.

In this study, we were unable to estimate the effects of manufacturers' advertising and promotion of smokeless tobacco products on initiation of use. Advertising and promotion of tobacco products may directly influence adolescents' normative beliefs about their use.⁴⁴ Advertising may act as an indirect normative influence by increasing peer pressure associated with the emulation of role models. A recent study suggested that exposure of male adolescents to smokeless tobacco advertisement may increase their likelihood of using these products.⁵⁰

Public health approaches to prevent smokeless tobacco use should include development of skills for responding to social influences to use tobacco, as well as education on short- and long-term health

consequences.^{51,52} Because of the effects of smokeless tobacco use by household members on the likelihood of regular use by young people (as well as the direct health risks associated with its use), public health activities should include cessation services. To help prevent initiation of tobacco use, the Food and Drug Administration has issued regulations that may reduce minors' access to smokeless tobacco and cigarettes, as well as reducing the appeal of these products.⁵³ □

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