

Evidence That Smokeless Tobacco Use Is a Gateway for Smoking Initiation in Young Adult Males¹

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Background. This study was designed to test the hypothesis that smokeless tobacco (SLT) serves as a gateway drug for smoking among young adult males.

Methods. A cohort ($n = 7,865$) of U.S. Air Force recruits who claimed to have never smoked cigarettes was followed prospectively for 1 year. The participants were male, 32.9% were ethnic minorities, and their average age was 19.84 years ($SD = 2.29$). Among recruits entering basic military training, 403 (5.1%) reported current SLT use and 198 (2.5%) reported a past history of SLT use.

Results. At the 1-year follow-up current SLT users were 233% more likely to have initiated smoking than nonusers (odds ratio = 2.33, 95% CI = 1.84–2.94). Similarly, recruits who reported past SLT use were 227% more likely to begin smoking than participants who had never used SLT (odds ratio = 2.27, 95% CI = 1.64–3.15). SLT use remained a potent predictor of smoking initiation in a multivariate logistic model that included demographic factors and other risk factors for initiation.

Conclusions. SLT use appears to be an important predictor of smoking initiation among young adult males. This study suggests that smoking prevention and cessation programs should also include strategies related to SLT use.

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Key Words: smokeless tobacco; smoking initiation; gateway drug; young adults; military recruits.

INTRODUCTION

Consumption of snuff and chewing tobacco, commonly referred to as “smokeless tobacco” (SLT), is associated with a number of serious medical diseases, including gingival recession, leukoplakia, nicotine addiction, increased cardiovascular mortality, and cancers of the oral cavity, larynx, and pharynx [1]. Unfortunately, SLT is often viewed as a safe alternative to cigarette smoking and its use among U.S. residents is increasing. For instance, between 1991 and 1997, SLT use increased 32% among high school students in the United States [2]. According to the 1997 Youth Risk Behavior Survey [2], approximately 9.3% of U.S. students in Grades 9 to 12 reported using smokeless tobacco in the 30 days prior to the survey. State prevalence rates varied from 5.1% (New York) to 22.5% (Wyoming). The greatest prevalence of SLT use occurs among white males and those from rural areas [3].

Not only is smokeless use associated with serious health effects, its use is linked with a high prevalence of other health risks. For instance, in a cross-sectional study of military recruits, we compared participants who reported never using tobacco (never users), those who only smoked cigarettes (smokers), individuals who used only SLT, and participants who used both smokeless tobacco and cigarettes (polyusers) on a variety of health-related factors [4]. We found that, as with smokers, SLT users reported a high prevalence of risky health behaviors, such as safety risk taking (e.g., driving fast) and alcohol use. SLT users actually reported a *higher* likelihood of binge drinking (i.e., eight or more alcoholic beverages per day) and less frequent use of seat belts than smokers. Furthermore, on several measures of health risk (e.g., risk taking, seat belt use, alcohol use, binge drinking, intake of high-fat foods), polyusers scored significantly higher than the other

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groups and the magnitude of these differences was typically striking.

In addition to the evidence that SLT use is a potent health risk factor and tends to co-occur with other harmful practices, several researchers have proposed that SLT use serves as a "gateway drug" for cigarette smoking [3,5]. For instance, Heishman *et al.* [6] hypothesized that the dramatic increase in smokeless use among adolescents has contributed to the increasing rates of smoking that occurred in the 1990s. Given that the negative health effects of cigarette smoking are even more dramatic than those associated with SLT use, examining the potential gateway effect of SLT use is an important area of research.

A small number of studies have reported the influence of SLT use on cigarette smoking using cross-sectional or retrospective designs. There are at least two lines of evidence that support the notion that SLT use is a gateway to cigarette smoking. First, if SLT users frequently transition to smoking, one would expect a significant relationship in the use of the two forms of tobacco. Indeed, a host of studies have found that SLT use and cigarette use co-occur in both adolescents and adults [7–10]. For instance, among white males (those with the highest rates of SLT use), Hatsukami and colleagues [8] found that in a nationally representative sample of adolescents in the United States, the prevalence of smoking was 60.2% among SLT users and 24.9% among nonusers.

Second, if SLT use leads to cigarette smoking, one would expect a significant proportion of polyusers (those using both cigarettes and SLT) to report using SLT prior to smoking in retrospective studies. Unfortunately, the evidence is mixed for SLT use preceding smoking in polyusers. In favor of the gateway hypothesis, Hunter and colleagues [11] found that early use of SLT was more common than early use of cigarettes in youth who participated in the Bogalusa Heart Study. Similarly, Glover *et al.* [12] noted that the prevalence of switching from SLT to smoking was more prevalent than the converse in a representative sample of college students in the United States. In a study by Peterson and colleagues [10] it was found that use of SLT or cigarettes predicted initiation of the alternative method. That is, SLT use predicted cigarette smoking initiation and cigarette smoking predicted onset of SLT use among adolescents. In contrast, Hatsukami and colleagues [8] found no evidence that SLT use tended to precede smoking onset in a group of 402 SLT users seeking assistance with quitting. Similarly, Gingiss and Gottlieb [13] found no evidence that SLT served as a gateway for smoking in a small sample ($n = 284$) of college athletes.

The current study provides the first prospective examination of this phenomenon in a population that is equally vulnerable to the influence of SLT use—young

adults. Given that SLT use may be a more acceptable form of nicotine administration within the social milieu of some children and the fact that SLT promotes nicotine addiction, it is possible that many childhood SLT users will progress to cigarette smoking as young adults when social constraints regarding smoking decrease. This study examined the incidence of smoking initiation among a large cohort of young military recruits who varied on SLT use but reported never smoking cigarettes.

METHODS

Description of the Parent Study

The Wilford Hall/University of Memphis and Minnesota Smoking Cessation Program is a collaborative endeavor between the two above-cited universities and the U.S. Air Force (USAF), funded by a grant from the National Institutes of Health (NHLBI). In this investigation, the entire population of Air Force Basic Military Training (BMT) recruits was randomized to either a smoking cessation program or control condition during a 6-week BMT-imposed tobacco ban. Every individual who entered the active duty service in USAF from August 1995 to August 1996 was a participant in the study ($n = 29,044$). A detailed description of the treatment portion of this project is published elsewhere [14]. Human subject protocol approval was obtained from the University of Memphis institutional review board as well as the USAF.

Procedure and Measures

Baseline Assessment

The baseline survey was a 53-item behavioral health risk questionnaire. Administration was in a group setting in "flights" (the USAF equivalent of platoons) of approximately 50 recruits. Instructions were read and recruits completed all items using a scannable questionnaire. All questionnaires were checked for completeness prior to the flight departing. Participants were informed that their responses would be confidential except in the most extreme circumstances. In addition, questions that could result in disciplinary action were not asked. The measure collected information from four general domains. First, basic demographics were assessed. Second, a history of tobacco use (smoking and SLT) was assessed. Regular SLT use was defined as using SLT at least once per day. Third, questions thought to be associated with smoking onset/relapse were asked. Two risk factors for smoking were used in this study due to their ability to discriminate between SLT use categories [4]: self-rated rebelliousness and safety risk taking. Finally, other health risk factors, such as alcohol use and physical activity, were assessed. Five health risk factors were used in this

study, again due to differences in the three SLT use categories (i.e., never users, past users, current users): seat belt use, alcohol use, binge drinking, physical activity level, and fruit/vegetable intake. Given the large-scale nature of the parent study, each factor was measured with single-item, epidemiological questions based on well-established surveys.

Given the numerous quality control checks and the fact that the baseline questionnaire was given as *part* of BMT, the response rate was extremely high. To derive an estimate of the stability of the measure, a 6-week test-retest reliability was performed on items using a randomly selected subgroup of trainees ($n = 7,080$). Specific to tobacco, the correlations of the smoking status ($r = 0.97$) and SLT use ($r = 0.93$) items indicated that participants reported their tobacco use in a highly consistent manner.

Follow-up Assessment

Securing follow-up data at the 1-year follow-up was challenging because study participants were stationed all over the world. However, the military is particularly adroit at locating personnel. This project collaborated with the USAF Survey Branch, whose sole mission is to conduct and complete worldwide USAF-approved surveys. At the 1-year follow-up, participants were located by the World Wide Locator in the Survey Branch, and addresses and phone numbers of participants were delivered to the project monthly. A brief survey (see below) was then mailed to participants. Those not responding to the initial and a follow-up survey were contacted by phone to obtain this information. A priori, the goal was to obtain 1-year follow-up data on 95% of smokers (given that the goal of the larger study was to reduce current smoking rates) and a sample of 60% of nonsmokers (to provide an adequate sample of nonsmokers for this and other studies). Final follow-up rates in the larger study were 96 and 66% for available smokers and nonsmokers, respectively. Not included in the follow-up were those who had dropped out of BMT, those who completed BMT but dropped out of the USAF by the 1-year follow-up, those who were deceased, and those who were "unavailable" (defined as being on assignments and not reachable) or in locations (e.g., Bosnia) where only secured radio communication was available. Smoking at follow-up was defined by 7-day point prevalence (smoking, even a puff, over the past 7 days).

Participants

Active duty recruits ($n = 29,044$) who participated in the parent study were screened for inclusion in this study. First, male participants ($n = 21,690$) who reported that they had never smoked regularly ($n = 14,340$; defined as smoking at least one cigarette per

day) prior to entry into the USAF were selected. Second, among never smokers, those who were selected for the 1-year follow-up assessment were identified ($n = 7,865$). These participants were divided into three groups based on baseline SLT use status: never users ($n = 7,264$), current users ($n = 403$), and past users ($n = 198$). Table 1 presents demographic differences between the three groups. There was a significant difference between groups on two factors, the percentage of participants from minority ethnic background ($X^2 = 187.2$, $P < 0.001$) and percentage of individuals from a low-income background ($X^2 = 12.6$, $P = 0.002$). Specifically, few ethnic minorities were either users or former users and the prevalence of low income was higher among never users compared with either past users or current users. Therefore, the analysis of smoking initiation was statistically adjusted for ethnicity and income.

RESULTS

Smoking Initiation

Univariate Analysis

Univariate logistic analysis of the risk of smoking initiation from SLT use, controlling for differences in demographic factors, revealed that past users were 227% more likely (Odds Ratio (OR) = 2.27, 95% CI = 1.64–3.15) and current SLT users were 233% more likely (OR = 2.33, 95% CI = 1.84–2.94) to initiate smoking than never users. Specifically, nearly 27% (107/403) of current SLT users initiated smoking, whereas 26.3% (52/198) of former users and 12.9% (940/7264) of never users began to smoke after BMT.

TABLE 1
Demographic Characteristics by SLT Use Status

Factor	Never users ($n = 7,264$)	Past users ($n = 198$)	Current users ($n = 403$)
Age (mean/SD)	19.81/2.16	19.96/2.03	19.74/2.06
Ethnicity			
% Euro-American ($n = 5,346$)	89.2	4.6	6.2
% African-American ($n = 1,117$)	99.6	0.2	0.2
% Hispanic-American ($n = 620$)	96.0	2.0	1.9
% Asian-American ($n = 297$)	97.8	1.3	0.9
% Other ($n = 485$)	96.7	1.1	2.1
Income (% < \$20,000)	23.9	15.7	18.6
Education (% some college)	38.2	39.4	38.2
Marital status (% single)	82.4	77.3	82.4

Multivariate Analysis

Next, we assessed the relative predictive ability of SLT use on smoking initiation when statistically adjusting for the predictive ability of other risk factors for smoking and demographic differences among the groups. Based on our previous study of risk factors for smoking that distinguish SLT users from nonusers [4], the following variables were included in the multivariate analysis: safety risk taking, rebelliousness, seat belt use, total alcohol use, binge drinking, physical activity level, and intake of fruits and vegetables. Figure 1 presents the results of the multivariate model. SLT use, either past or current, was the most robust predictive factor, nearly doubling the likelihood of smoking initiation.

Characteristics of SLT Users, Past Users, and Never Users Who Initiate Smoking

Table 2 presents smoking demographics for participants in the three SLT use categories who initiated smoking following BMT. None of the smoking parameters were significantly different between the three groups. Most participants initiated within 6 months of BMT. As would be expected for new smokers, most smoked less than one pack each day, although a sizable proportion (>10%) had progressed to more than 20 cigarettes per day. Many of the smokers were ambivalent about their tobacco use, as is evidenced by the significant proportion who had attempted to quit and who were seriously considering smoking cessation.

DISCUSSION

This study supported the hypothesis that SLT use is a potent predictor of smoking initiation among a group

TABLE 2

Tobacco Demographics at 1-Year Follow-up among Initiators

Factor	Never users (n = 940)	Past users (n = 52)	Current users (n = 107)
Time to initiation after BMT			
% Within 1 week	12.8	17.3	18.7
% Within 1 month	25.3	28.8	24.3
% Within 6 months	48.0	44.3	47.6
% > 6 months	13.9	9.6	9.4
Number of cigarettes smoked per day in past 7 days			
% ≤ 10	70.7	67.3	70.1
% 11–20	16.4	17.3	16.8
% > 20	12.9	15.4	13.1
% Attempting to quit smoking after BMT	41.6	34.6	42.1
% Seriously considering quitting in next 30 days	49.1	44.2	49.5
% Seriously considering quitting in next 6 months	34.8	40.4	35.5

of never smokers entering the USAF. Both current and former SLT users were more than twice as likely to initiate smoking than those who had never used SLT. These findings are consistent with studies conducted with adolescents [e.g., 15] which suggest that SLT serves as a gateway drug for cigarette smoking. It appears that not only does smoking and SLT use co-occur as demonstrated in a study by Hatsukami and colleagues [8], but SLT use often leads to cigarette smoking.

The reasons why SLT use preceded cigarette smoking in this sample are unclear. However, lower family disapproval for SLT use than for cigarette smoking may be a contributing factor. For example, Ary and colleagues

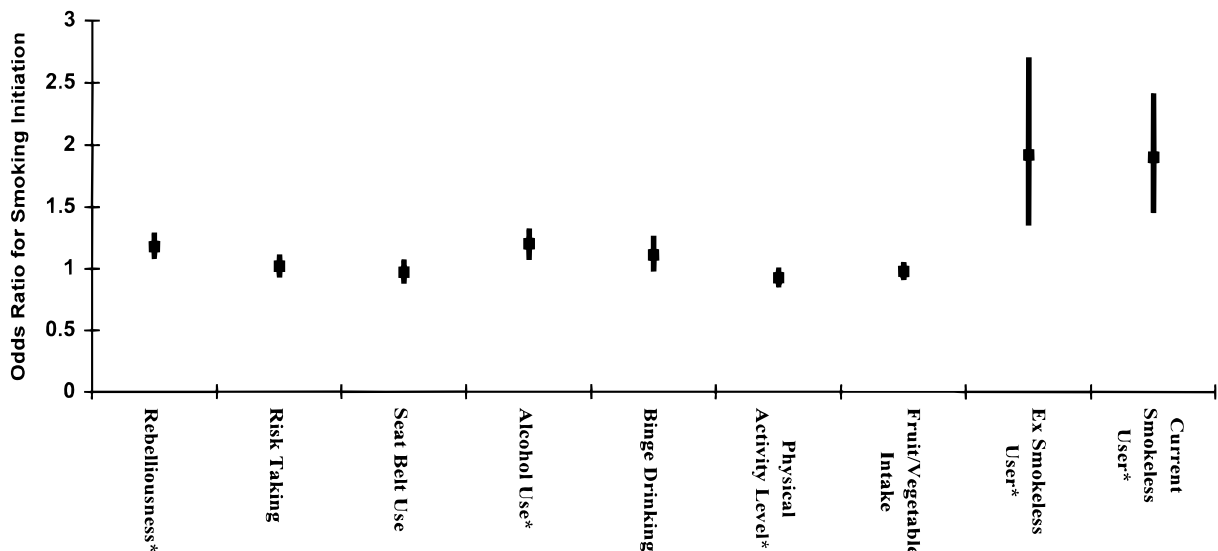


FIG. 1. Multivariate model of risk factors for smoking initiation. High/low Lines represent 95% confidence interval. Asterisks denote significant predictors, $P < 0.05$. Model adjusted for demographic differences between smokeless use categories.

[16] noted that parents of SLT users are more likely than parents of cigarette smokers to be aware of their child's use of SLT products and to tolerate such use. Similar findings have also been noted by Chassin *et al.* [17] and by Boyle and colleagues [18]. Conversely, a contributing factor may also be the ease in which use of SLT can be concealed relative to cigarette smoking both at home and at school. Further, these restrictions are lifted as independence is gained in young adulthood, inviting the option to smoke cigarettes.

Social influences may be another consideration in why SLT use may precede cigarette smoking. Several studies [e.g., 19,20] found that the image associated with SLT use among adolescents was more positive relative to that of cigarette smoking. It may be that the perceived positive image of SLT use changes with age, prompting a switch to the more "sophisticated" look that is commonly associated with cigarette smoking.

Another potential mechanism linking SLT consumption with cigarette smoking is that SLT serves as a "starter" product for subsequent tobacco use [21,22]. Kessler and colleagues have documented that tobacco manufacturers knowingly market SLT products with lower levels of nicotine in an effort to eventually graduate the users to a higher nicotine product [21]. Therefore, SLT users in this study may have initially developed addiction to nicotine with low-yield SLT products and moved to smoking once they entered the military.

Another finding in the sample under study was that the greatest predictor of smoking initiation in a multivariate analysis was past or current SLT use at baseline. Additional predictors of smoking onset were rebelliousness, physical activity level, and alcohol use. Numerous studies have demonstrated the association between cigarette smoking and risk taking behaviors and substance use [cf, 23]. For example, in the National Household Survey on Drug Abuse [24], young adults aged 18 to 25 who were current smokers were significantly more likely to be using alcohol, marijuana, and cocaine than never smokers.

Similar to previous research in this area [25], SLT users in this study tended to be white. Ethnic minorities were less likely to use SLT than their white counterparts. In addition, as opposed to the literature on cigarette smoking and socioeconomic status [26], and consistent with previous literature on socioeconomic status and SLT use [23], the present study indicated that the prevalence of low family income (i.e., total family income prior to BMT) was higher among never users as compared with past and current users. This suggests that limited income may be a greater barrier to SLT than cigarette use or that SLT use is more acceptable among higher-income families.

The large number of nonsmokers who initiate smoking following BMT is disturbing from a preventive medicine perspective. The high initiation rates among both

SLT users and nonusers is inconsistent with epidemiological studies based on the civilian population where most smoking initiation occurs prior to age 18 years [23]. Thus, interventions aimed at reducing smoking initiation among military recruits are desperately needed. The vast majority of initiation of cigarette smoking was within 6 months post-BMT. This suggests that the posttraining environment (i.e., technical training) may be an opportune time to deliver supplemental prevention messages. First, given the large percentage of those interested in making a quit attempt, it is likely that the recruits would be receptive to strategies for smoking cessation. Second, among the airmen who initiated cigarette smoking, the rate of smoking in most was relatively low. Therefore, physiological dependence on nicotine is likely to be low and less of a barrier to quitting.

Along this line, this study suggests that smoking prevention and cessation programs should also include strategies related to SLT use. Most SLT initiation occurred during adolescence in this group (average age of participants who used SLT was 19.7 years) and these SLT users were at high risk for smoking initiation as young adults. Thus, addressing SLT use during smoking prevention efforts may reduce the rate of adult smoking initiation. For instance, the military might consider targeting SLT users at the beginning of BMT with tobacco prevention counseling to determine whether an intervention can promote SLT cessation and prevent smoking initiation. This suggestion does not imply that most smokers first use SLT. Many factors contribute to smoking initiation and many more smokers have not used SLT than those who have. However, SLT use does appear to be one important risk factor for smoking initiation and addressing its use is a reasonable addition to prevention programs.

Although this study offers several methodological advantages (e.g., large, nationally recruited, and diverse sample; prospective data), because the participants are limited to military recruits the generalizability of the findings may be limited. Factors such as the personal characteristics of those who join the military, the unique nature of BMT, the 6-week tobacco ban, and the requirements of military service suggest that this population is unique. Therefore, future studies should examine whether SLT use leads to adult smoking initiation in other groups. Similarly, because of the low prevalence of SLT use among women, the generalizability of the findings to females is uncertain. The results of this study were based on self-reports of smoking status; therefore, the prevalence rates reports may be underestimates of actual tobacco use. Finally, we were unable to identify mechanisms linking SLT use to adult-onset smoking. Future research should examine the mechanisms involved in smoking initiation among SLT users, such as cognitive (i.e., greater acceptance of tobacco

use), social (i.e., greater number of friends who use tobacco), and biological (i.e., nicotine dependence) factors.

CONCLUSION

This study found that in a large, diverse sample of military recruits, SLT use was associated with a significantly increased risk of adult-onset smoking initiation. The predictive ability of SLT use remained strong when other predictors of smoking initiation (e.g., alcohol use, risk taking, other health habits) were included in a multivariate model. Thus, smoking prevention and cessation programs should include strategies related to SLT use. In addition, future research should examine whether interventions with SLT users could prevent smoking initiation among military recruits.

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