Snuff Use and Smoking in U.S. Men
Implications for Harm Reduction

Scott L. Tomar, DMD, DrPH

Background: Encouraging smokers to switch to snuff may have unintended public health implications. This study examined the associations between snuff use and smoking in a representative sample of U.S. men.

Methods: Subjects were males aged ≥18 years in the National Health Interview Survey (N=13,865). The data analysis was conducted between August 2001 and April 2002. Multiple logistic regression modeling was used to examine the association between using snuff and quitting smoking.

Results: In 1998, 26.4% of U.S. men smoked, 3.6% used snuff, and 1.1% used both products. Adjusting for age and race/ethnicity, current smoking was most prevalent among males who used snuff on some days (38.9%) and lowest among those who used snuff every day (19.2%). Daily snuff users were significantly more likely than never-users to have quit smoking in the preceding 12 months (odds ratio [OR]=4.23; 95% confidence interval [CI]=2.16–8.28). However, U.S. men were more likely to be former snuff users who currently smoked (2.5%) than to be former smokers who currently used snuff (1.0%). Occasional snuff users (some day users) were more likely than never users to have tried to quit smoking in the preceding year (OR=1.69; 95% CI=1.04–2.76) but tended to be less likely to succeed (OR=0.50; 95% CI=0.19–1.33).

Conclusions: Some men may use snuff to quit smoking, but U.S. men more commonly switch from snuff use to smoking. Some smokers may use snuff to supplement their nicotine intake, and smokers who also use snuff are more likely than nonusers to try to quit smoking but tend to have less success.

Medical Subject Headings (MeSH): health promotion, nicotine, smoking cessation, tobacco, smokeless (Am J Prev Med 2002;23(3):143–149) © 2002 American Journal of Preventive Medicine

Introduction

Oral use of snuff is capable of delivering rapid, high dosages of nicotine[1,2] and can result in levels of nicotine dependence comparable to those seen in smokers.[3] There is substantial evidence that manufacturers of snuff can and do manipulate the nicotine-dosing characteristics of their products to create low nicotine dosage "starter" products, which are targeted toward novice users, and a range of medium- and high-dosage products, which are targeted toward more experienced users as they progress in their levels of nicotine tolerance and dependence.[4–8]

Several expert panels have concluded that oral use of snuff can cause cancer in humans.[9–11] This conclusion recently has been questioned, at least concerning Swedish brands of moist snuff, or "snus."[12] Other researchers acknowledge that snuff is a risk factor for cancers of the oral cavity and pharynx, but claim that switching from smoking to use of snuff would save thousands of lives because of a reduction in risk for other smoking-associated diseases.[13,14] On that basis, the use of snuff has been advocated as a method for quitting smoking in both professional and lay publications,[13,15] although the only evidence supporting the efficacy of snuff use as a method for quitting smoking comes from one uncontrolled pilot study[16] whose methodology and approach have been criticized.[17–20] Some researchers have attributed the decline in cigarette smoking among Swedish men from 36% in 1980 to17% in 1998 to a switch to use of snus,[21,22] and there have been recent calls for a lifting of the ban on sales of oral snuff products in European Union (EU) countries (Sweden was exempt when it joined EU in 1995).[12] However, there is little evidence supporting the role of snus in reducing smoking among men in Sweden:

From the University of Florida College of Dentistry, Division of Public Health Services and Research, Gainesville, Florida

Address correspondence to: Scott L. Tomar, DMD, DrPH, University of Florida College of Dentistry, Division of Public Health Services and Research, 1600 SW Archer Road, P.O. Box 100404, Room D8-38, Gainesville, Florida 32610. E-mail: stomar@dental.ufl.edu.

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the prevalence of smoking among Swedish women also has been declining in recent years without any appreciable use of snus by women, snus use by men increased by less than two percentage points between 1980 and 1998, and Sweden has experienced a broad range of tobacco-control efforts during that time period.[23,24] U.S. Smokeless Tobacco Company (USST), the nation's leading manufacturer of smokeless tobacco products, clearly has been marketing some of its products as supplements to smoking, particularly in response to smoke-free policies. USST recently petitioned the U.S. Federal Trade Commission for permission to make explicit claims that its products are less hazardous than cigarettes. Despite the theoretical benefits of getting smokers who are unable to quit to switch to less harmful forms of tobacco use, the feasibility of such a "harm-reduction" approach to tobacco control is unknown.[25]

See related Commentary on page 226.

The widespread availability of moist snuff products, the increased prevalence of clean indoor air policies in the United States,[26] marketing of snuff products to smokers, and advocacy by some health professionals of switching to the use of snuff raises two opposing questions of public health relevance:

- Can snuff help smokers to quit smoking?
- Does partial substitution of smoking with snuff reduce smokers' success in quitting?

The purpose of this study was to examine the patterns of snuff use in relation to current smoking, former smoking, and quit attempts in a representative sample of U.S. men.

Methods

Subjects

Data for this study were drawn from the 1998 National Health Interview Survey (NHIS), a multipurpose health survey conducted by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention (CDC). The NHIS is representative of the civilian, noninstitutionalized, household population of the United States, and has been conducted continuously since 1957. Data were collected through personal household interviews. Adult participants in the 1998 NHIS were asked about their cigarette-smoking history. These questions are asked every year in the NHIS. In addition, adult respondents were asked about their use of smokeless tobacco. The NHIS includes questions on the use of smokeless tobacco approximately every 3 to 4 years, and 1998 was the most recent year in which these questions were asked.

The interviewed sample for 1998 consisted of 38,209 households, which yielded 98,785 persons in 38,773 families, including a sample of 32,440 persons aged ≥18 years. The final response rate for the adult sample was 73.9%. Further details about the design and conduct of the 1998 NHIS are contained in the documentation prepared by the NCHS, available at ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/1998/srvydesc.pdf. Analysis was limited to males (n=14,202) because they comprise nearly all snuff users in the United States. Complete data on smoking status and snuff use were available for 13,865 male respondents (97.6%).

Current cigarette smokers were persons who reported smoking at least 100 cigarettes in their lifetime and smoked every day or on some days at the time of the survey; former smokers had smoked at least 100 cigarettes but reported they did not currently smoke at all; and never smokers had not smoked 100 cigarettes. Current snuff users were persons who reported they had used snuff at least 20 times in their lifetime and used it every day or some days at the time of the survey; former snuff users had used it at least 20 times but did not currently use it at all; and never users had not used snuff 20 times. These are the operational definitions developed and used by the CDC Office on Smoking and Health.[27] Smoking quit ratios were calculated as the proportion of ever smokers who were former smokers at the time of the interview; that is, [(former smokers)/(former smokers + current smokers)] × 100%.[28] Past-year quit ratios were calculated as [past year quitters/(past year quitters + current smokers)] × 100%.

Data Analysis

The NHIS is cross-sectional in design, but because respondents provided information on both current and past tobacco use, it was possible to examine the association between former smoking and current use of snuff and vice versa. Data were weighted to the U.S. population, and, because of the complex survey design, were analyzed by using the SUDAAN software package (Research Triangle Institute, Research Triangle Park, NC, 2002). The data analysis was conducted between August 2001 and April 2002. For most comparisons of prevalence estimates, data were adjusted by the direct method to the age and race/ethnicity distribution of the 1998 U.S. male population. Prevalence estimates and 95% confidence intervals (CIs) were calculated for snuff use and smoking status. Estimates whose CIs did not overlap were considered significantly different from each other.

The mean number of cigarettes smoked per day and the prevalence of recent attempts to quit smoking among current smokers was assessed in relation to snuff use. Multiple logistic regression modeling was used to measure the association between snuff use and quitting smoking, adjusting for age, race/ethnicity, geographic region, and educational attainment. The prevalence odds ratio (OR) was the measure of association. OR estimates whose 95% CI excluded 1.0 were interpreted as indicating a statistically significant degree of association. Estimates of the mean number of cigarettes smoked per day were adjusted to the age and race/ethnicity distribution of the 1998 U.S. adult male population. The pairwise t test procedure within SUDAAN DESCRIPT procedure was used to test the null hypothesis of no difference in the means of two groups.

Results

Prevalence of Tobacco Use

In 1998, 26.4% of U.S. males aged ≥18 years were current smokers and 3.6% were current snuff users

Table 1. Prevalence of current[a] tobacco use among males aged ≥18 years, by selected demographic characteristics (N=13,865)

		Cigarettes		Snuff	
Characteristic	*n*	**%**	**(±95% CI)**	**%**	**(±95% CI)**
Age (years)					
18–24	1458	31.2	(2.8)	5.4	(1.4)
25–44	5979	29.4	(1.4)	4.8	(0.7)
45–64	4029	27.7	(1.6)	1.8	(0.5)
65+	2399	10.4	(1.2)	1.6	(0.6)
Race/ethnicity					
Hispanic	2182	24.9	(2.3)	1.0	(0.5)
White[b]	9598	26.5	(1.1)	4.4	(0.5)
Black[b]	1609	29.1	(2.5)	0.5	(0.3)
Other[b]	476	22.3	(3.9)	2.5	(1.6)
Education					
<High school	2868	35.4	(2.0)	4.0	(0.9)
High school	3878	33.2	(1.8)	4.0	(0.8)
>High school	7035	19.5	(1.1)	3.2	(0.5)
Geographic region					
Northeast	2565	25.0	(2.2)	1.5	(0.5)
Midwest	3257	28.3	(2.0)	3.9	(0.9)
South	4963	28.5	(1.4)	4.8	(0.8)
West	3080	21.5	(1.7)	3.0	(0.7)
Location of residence[d]					
Within MSA	11059	25.8	(1.0)	2.8	(0.4)
Outside MSA	2806	28.7	(1.9)	6.5	(1.0)
Total	13865	26.4	(0.9)	3.6	(0.4)

[a]Current smoking: smoked ≥100 cigarettes in lifetime, now smoke every day or on some days. Current snuff use: used snuff ≥20 times in lifetime, now use snuff every day or on some days. Percentages are weighted to the 1998 U.S. population.
[b]Not of Hispanic origin.
[c]Northeast: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania; Midwest: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas; South: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, Texas; West: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, Hawaii.
[d]MSA is metropolitan statistical area. An MSA is a county or group of contiguous counties that contain at least one city with a population of 50,000 or more or includes a Census Bureau–defined urbanized area of at least 50,000 with a metropolitan population of at least 100,000.
CI, confidence interval.

(Table 1). Snuff use was more prevalent among males aged 18 to 44 years than among those in older age groups and was more prevalent among non-Hispanic white males than among Hispanics or non-Hispanic blacks. Smoking was more prevalent among males with a high school education (33.2%) or less (35.4%) than among those with more than a high school education (19.5%). In contrast, snuff use did not differ significantly by level of educational attainment. Both smoking and snuff use were significantly more prevalent among residents of rural areas (i.e., outside of metropolitan statistical areas [MSAs]) of the United States than within MSAs. Among current male smokers, 82% reported smoking every day (data not shown). In comparison, 56% of current snuff users reported using snuff every day and 44% used it on some days.

Associations Between Smoking and Snuff Use

After adjusting for age and race/ethnicity, the prevalence of current smoking was higher among former snuff users (39.4%) and males who used snuff on some days (38.9%) than among those who used snuff every day (19.2%) or never used snuff (25.4%) (Table 2). The smoking quit ratio was lowest for men who used snuff on some days (42.6%) and highest among those who were daily snuff users (63.5%). The past-year smoking quit ratio also was lowest for men who used snuff on some days (5.3%) and highest for men who used snuff every day (23.2%).

After adjusting for respondents' age, race/ethnicity, educational attainment, urban/rural residence, and geographic region, ever smokers who currently used snuff every day were more likely than those who never used snuff to have quit smoking (OR=3.22, 95% CI=1.98–5.21) or to have quit within the past year (OR=4.07, 95% CI=2.07–8.00) (Table 3). Ever smokers who used snuff on some days tended to be about half as likely as never users to have quit smoking, but the confidence intervals for those OR estimates were wide and included 1.0.

The net population impact of concurrent use or switching between these products was estimated by examining the cross-classification of the status of smok-

Table 2. Cigarette smoking status and smoking quit ratios, by status of snuff use[a]

Status of snuff use	Current smoking			Former smoking			Smoking quit ratios	
	All current smokers % (±95% CI)	Smoke every day % (±95% CI)	Smoke some days % (±95% CI)	All former smokers % (±95% CI)	Quit ≤1 year % (±95% CI)	Quit >1 year % (±95% CI)	Smoking quit ratio[b] %	Past-year smoking quit ratio[c] %
Current use every day	19.2 (4.9)	11.7 (4.2)	7.5 (2.5)	33.4 (6.6)	5.8 (2.9)	27.6 (6.2)	63.5	23.2
Current use some days	38.9 (7.7)	32.7 (7.5)	6.2 (3.2)	28.9 (7.0)	2.2 (2.3)	26.8 (6.9)	42.6	5.3
Former	39.4 (3.8)	33.0 (3.8)	6.3 (2.0)	41.2 (3.4)	7.9 (2.2)	33.2 (2.9)	51.1	16.7
Never	25.4 (1.0)	20.9 (0.9)	4.5 (0.4)	26.3 (0.8)	3.2 (0.4)	23.1 (0.8)	50.9	11.2
Total	26.5 (0.9)	21.6 (0.8)	4.8 (0.4)	27.4 (0.8)	3.6 (0.4)	23.8 (0.7)	50.8	12.0

[a]Among males aged ≥18 years, adjusted to the 1998 U.S. male population by age (four groups) and race/ethnicity (four groups).
[b]Smoking quit ratio: [former smokers / (former smokers + current smokers)] × 100%.
[c]Past-year smoking quit ratio: [past year quitters / (past year quitters + current smokers)] × 100%.
CI, confidence interval.

ing and snuff use (Table 4). This distribution revealed that U.S. men were about 2.5 times more likely to be former snuff users who currently smoked (2.5%) than to be former smokers who currently used snuff (0.9%). About 1.1% of U.S. men concurrently used both products.

Smoking Quit Attempts and Snuff Use

To examine whether smokers who also use snuff may differ from those who do not use snuff in their desire to quit smoking, the percentage of current smokers who reported that they tried to quit smoking for at least 1 day within the preceding 12 months was calculated, stratified by snuff use status (Table 5). Overall, 40.9% of male smokers reported at least one attempt to quit smoking in the preceding 12 months. After adjusting for age, race/ethnicity, educational attainment, and geographic region, male smokers who used snuff only on some days were more likely than those who never used snuff to have tried to quit smoking in the preceding 12 months (OR=1.68; 95% CI=1.03–2.72). Smokers who were former or daily snuff users did not differ from never users in their likelihood of reporting an attempt to quit smoking.

Cigarettes Smoked Per Day and Snuff Use

After adjusting for age and race/ethnicity, smokers who used snuff tended to smoke fewer cigarettes per day, on average, than those who never used snuff (17.6 vs 18.4; $p=0.32$). However, smokers who used snuff only on some days did not differ from those who never used snuff in the mean number of cigarettes smoked per day (19.3 vs 18.4; $p=0.42$), while those who used snuff every day smoked, on average, significantly fewer cigarettes per day (11.4; $p=0.0001$).

Table 3. Adjusted[a] odds ratio estimates for quitting smoking

Status of snuff use	Quit Smoking[b] OR (95% CI)	Quit Smoking in Past Year[c] OR (95% CI)
Every day	3.23 (1.99–5.24)	4.23 (2.16–8.28)
Some days	0.66 (0.42–1.06)	0.50 (0.19–1.33)
Former	1.16 (0.94–1.43)	1.51 (1.06–2.15)
Never	Referent	Referent

[a]Adjusted for age (18–24, 25–44, 45–64, ≥65 years); race/ethnicity (Hispanic, non-Hispanic white, non-Hispanic black, other); geographic region (Northeast, Midwest, South, West); residence in a metropolitan statistical area (yes/no); and educational attainment (<high school, high school, >high school). Based on logistic regression modeling.
[b]Excludes men who never smoked.
[c]Excludes men who never smoked or quit smoking >1 year before interview.
CI, confidence interval; OR, odds ratio.

Discussion

Daily snuff users were significantly more likely than men who never used snuff to have quit smoking. This

Table 4. Population distribution of concurrent smoking and snuff use status among males aged ≥18 years[a]

Smoking status	Status of snuff use: Current % (±95% CI)	Former % (±95% CI)	Never % (±95% CI)	Total % (±95% CI)
Current	1.1 (0.2)	2.5 (0.3)	22.8 (0.9)	26.4 (0.9)
Former	0.9 (0.2)	2.2 (0.3)	24.2 (0.8)	27.4 (0.8)
Never	1.5 (0.2)	1.3 (0.2)	43.3 (1.0)	46.1 (1.0)
Total	3.5 (0.4)	6.1 (0.5)	90.3 (0.6)	100.0

[a]Adjusted to the 1998 U.S. male population by age (four groups) and race/ethnicity (four groups).
CI, confidence interval.

Table 5. Attempts by male current smokers aged ≥18 years to quit smoking, by status of snuff use

	Made one or more quit attempts in preceding 12 months	
Snuff use	**% (±95% CI)**	**OR[a] (95% CI)**
Every day	42.8 (16.4)	1.13 (0.57, 2.27)
Some days	54.3 (11.9)	1.68 (1.03, 2.72)
Former	45.2 (6.5)	1.21 (0.91, 1.60)
Never	39.9 (2.0)	Referent
Total	40.9 (1.9)	

[a]Odds ratio adjusted for age (18–24, 25–44, 45–64, ≥65 years); race/ethnicity (Hispanic, non-Hispanic white, non-Hispanic black, other); geographic region (Northeast, Midwest, South, West); residence in a metropolitan statistical area (yes/no); and educational attainment (<high school, high school, >high school). Based on logistic regression modeling.
CI, confidence interval; OR, odds ratio.

pattern suggests that snuff may serve as an alternative form of nicotine dosing for smokers who will not or cannot overcome their nicotine dependence, and perhaps can help smokers to quit. However, 2.5 times as many men in the United States followed the opposite pattern, and were former snuff users who were current smokers at the time of the interview.

This study provides further evidence that snuff use may be a "gateway" form of nicotine dosing among males in the United States that may lead to subsequent cigarette smoking. The prevalence of smoking was substantially higher among men who had quit using snuff than among those who had never used snuff, suggesting that more than 40% of men who had been snuff users continued or initiated smoking. These findings are consistent with the results of a national longitudinal cohort study of adolescent and young adult males in the United States[29] and a recent cohort study of male military recruits.[30] Both of those studies concluded that young males who used smokeless tobacco products were significantly more likely than nonusers to initiate cigarette smoking. Many cross-sectional studies reported similar patterns of smokeless tobacco use in relation to cigarette smoking among males,[31–42] although the current study is the first to examine these patterns in a nationally representative sample of adult males.

This study provides some evidence that snuff use may be keeping smokers in the market who otherwise might have quit. Male smokers who used snuff on some days were more likely than never users to report trying to quit smoking within the preceding 12-month period. Yet, men who used snuff on some days had the lowest smoking quit ratio of any group. It is unknown whether these men viewed snuff use as a means of harm reduction, but those who used snuff on some days continued to smoke, on average, as many cigarettes per day as those who did not use snuff.

There is evidence that snuff may serve as a supplemental source of nicotine dosing for some current male smokers; nearly one half of men who used snuff on some days were current smokers, and those who currently smoked only on some days were more likely than never smokers to be current snuff users. Male smokers who used snuff every day smoked, on average, fewer cigarettes per day, again suggesting that snuff may have served as a supplementary source of nicotine dosing. It remains to be seen whether that pattern of lower cigarette consumption among concurrent daily snuff users is sustained over time and whether it truly represents reduced risk for disease.

There are several public health implications of the findings from this study. Although the principle of harm reduction may be philosophically appealing, it is highly doubtful that *ad libitum* use of snuff in the U.S. has produced a net public health benefit. The major concerns of promoting a dangerous product as less harmful than another are that it may undermine efforts to achieve total tobacco-product cessation or foster smoking initiation among people who otherwise would not have started.[25] In the present study, only about half of snuff users used it every day and nearly 20% of daily snuff users also were smokers. In addition, nearly 40% of occasional (some day) snuff users also were smokers. While a relatively small percentage of male smokers switched completely to snuff, significantly more men switched in the opposite direction. Thus, even though a product may be marketed and promoted as an alternative to smoking, there is a strong possibility that it could produce a contrary effect in the population. Indeed, many snuff products in the United States appear to be designed specifically to appeal to new, young users: they incorporate flavorings and sweeteners that may appeal to young people,[4] starter brands have relatively low pH levels and other product characteristics that result in slower rates of nicotine absorption and therefore facilitate development of nicotine tolerance,[2] and use of these products is relatively easy to conceal. The major manufacturer of moist snuff in the United States also has been marketing its products as supplementary sources of nicotine intake for smokers facing smoking restrictions. Findings from this study suggest that a large proportion of snuff users also are smokers. Thus, widespread marketing and availability of these products coupled with perceived harm reduction may produce a negative net public health effect if snuff use fosters subsequent smoking among young people and reduces one of the effects of clean indoor air policies, which is to encourage smokers to quit. These effects may outweigh the relatively small number of smokers who are able to completely quit smoking by switching to snuff use.

Although this study was limited to males because of the low national prevalence of snuff use among women, there are regions and subpopulations in the United States where snuff use is fairly common among females.

For example, 9.1% of high school girls in Alaska, 6.4% in South Dakota, and 6.0% in Wyoming were current smokeless tobacco users in 1999, compared to 1.3% of high school girls nationally.[43] Recent studies reported that in North Carolina, >20% of Lumbee women were current users of smokeless tobacco[44] and 33% of Cherokee women had ever used these products.[45] In fact, former smokeless tobacco use was found to be a significant predictor of current smoking among Lumbee and Cherokee women,[44,45] again indicating that smokeless tobacco may act as a gateway to nicotine addiction and cigarette smoking. A subsequent study conducted among Lumbee Indian women found that 18.3% of smokers also used smokeless tobacco.[46] Dual tobacco-product users in that study smoked, on average, fewer cigarettes per day than did exclusive cigarette smokers, perhaps reflecting supplementary nicotine dosing from smokeless tobacco among dual tobacco users. Although the present study was limited to males, the issue of snuff use as a risk factor for cigarette smoking and a supplemental source of nicotine dosing for smokers is clearly relevant to both genders.

Supplementation of smoking with snuff may have reduced smokers' success in quitting smoking while probably not appreciably reducing their risk for smoking-associated disease. A similar pattern was seen with the introduction of "light" and "ultralight" cigarettes in the U.S. market. Many smokers thought that they were reducing their risk for smoking-associated disease by switching to cigarettes with lower "tar" and nicotine yields, smokers who used low-yield cigarettes were more likely than smokers of high-yield cigarettes to report interest in quitting, and smokers who otherwise might have quit may have chosen instead to switch to products that they perceived as less harmful.[47] In reality, the risk reduction for the individual switching to low tar and nicotine cigarettes was minimal[48] and the net public health effect of low-yield cigarettes probably was negative.[25]

There are several limitations in this study that should be considered in interpreting its findings. First, all estimates of tobacco use are based strictly on self-reported behavior. In general, self-reported smoking status is reasonably valid for adults,[28] although smokers may tend to under-report daily consumption.[49] There are few studies on the validity of self-reported use of smokeless tobacco among adults,[50] although the NHIS has provided reliable national estimates on smokeless tobacco use since 1970.

Although this study was able to examine the association between cigarette smoking and use of snuff, there was no information on the reasons for using these products concurrently or for switching between them. The NHIS also collected no information on the duration of snuff use or quantity of snuff used per day. There was no information on whether smokers or snuff users used any pharmaceutical products to help them quit. The NHIS also collects no information on tobacco users' degree of nicotine dependence, which precludes its consideration in analyses of the relationships among snuff use, current smoking, and smoking cessation.

In conclusion, some men may use snuff to quit smoking, but U.S. men more commonly switch from snuff use to smoking. Some smokers may use snuff to supplement their nicotine intake, and smokers who also use snuff are more likely than nonusers to try to quit smoking but tend to have less success.

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