

Smokeless Tobacco Use among Male Adolescents: Patterns, Correlates, Predictors, and the Use of Other Drugs¹

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Questionnaire data from a sample of 3,023 adolescents indicated that over 60% of boys have tried smokeless tobacco, and 7% use it daily. Daily users reported an average of 5.3 uses per day. Among boys the prevalence of smokeless tobacco use in the past 6 months (18.8%) was higher than that for cigarette use (10.4%). For 86% of boys, the initial use of smokeless tobacco occurred in a social setting with other boys. Split-sample discriminant analyses identified peer use of smokeless tobacco as a discriminator between users and nonusers. Male triers of smokeless tobacco were discriminated from those who had never tried it by whether they had also tried smoking, intended to smoke, or had peers who used smokeless tobacco. Nine-month longitudinal data indicated that onset of smokeless tobacco use was not well predicted. Among daily users, the initial rate of use was the best prospective predictor of rate of use at follow-up ($r = 0.576$). Smokeless tobacco use was related to the use of other drugs, with 83% of male daily users indicating concurrent use of alcohol, marijuana, and/or cigarettes ($r = 0.354, 0.210, \text{ and } 0.284$, respectively). The use of smokeless tobacco was a prospective risk factor for the onset or increased use of cigarettes, alcohol, or marijuana. © 1987 Academic Press, Inc.

INTRODUCTION

Recently, there have been significant increases in the use of smokeless tobacco by adolescents, particularly among young males (12). Between 1974 and 1979, the sale of smokeless tobacco products in the United States increased by approximately 11% annually (6), and there has been a 56% increase in the sales of moist snuff between 1980 and 1984 (14). Smokeless tobacco products are being actively promoted in advertising campaigns aimed at young adults and teenagers. Several recent studies suggest significant prevalence rates among adolescent boys (4, 5, 15, 17, 18, 21). Up to 23% of male adolescents have reported daily use of smokeless tobacco (17), and the prevalence of smokeless use has tended to equal or surpass cigarette smoking among male adolescents in these studies. There seems to be little smokeless tobacco use among girls.

There are at least two bases for concern about the prevalence of smokeless tobacco use among male adolescents. First, regular use of smokeless tobacco may have significant long-range health consequences for today's adolescents (23, 25). The Advisory Committee to the Surgeon General reported that "[t]he scien-

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tific evidence is strong that the use of smokeless tobacco can cause cancer in humans'' (24). Second, there is concern that adolescents who have developed a smokeless tobacco habit may be primed to take up cigarette smoking at some later time to meet their nicotine dependency. The interdependence of smokeless tobacco use and smoking is evidenced in at least one study (7), which reported that for adolescents classifying themselves as having quit smoking, the likelihood of relapse was higher for smokeless tobacco users.

There are little or no available data on the behavioral and psychosocial aspects of the onset and use of smokeless tobacco. One study (5) found that adolescent boys viewed smokeless as less hazardous and more socially acceptable than smoking. Beliefs about health consequences, social acceptability, and the social image of smokeless tobacco were related to current use and intentions to use by current nonusers. Lichtenstein *et al.* (17) and Severson *et al.* (21) found that smokeless tobacco use and cigarette smoking covaried modestly, but that smokeless tobacco use was more strongly related to alcohol and marijuana use. In addition, users of smokeless tobacco tended to have friends who used smokeless tobacco and/or who smoked.

This study provides additional information on the prevalence and patterns of behavioral and psychosocial correlates of smokeless tobacco use. Discriminant analyses are employed to identify concurrent variables that distinguish users and triers from nonusers of smokeless tobacco. Longitudinal data permit an analysis of the stability of smokeless tobacco use (and other substances) over a 9-month period. Prospective factors related to onset of use and continued use of smokeless tobacco are examined. The relationship between smokeless tobacco use and the use of other drugs is analyzed.

METHODS

As part of an ongoing smoking prevention program, 3,023 male and female students in grades 7 through 10 were assessed at baseline and then retested 9 months later. The students were from nine middle schools and four high schools in four school districts in Oregon. The schools came from two different geographical locations, which included mostly suburban and some rural areas. The ethnic makeup of the male adolescent sample, the focus of this report, was 92.1% white, 2.7% American Indian, 2.0% Asian, 1.3% black, and 1.2% Hispanic.

The students completed a questionnaire which asked about their use of cigarettes, smokeless tobacco, marijuana, and alcohol, as well as demographic and descriptive information. The questionnaires were administered in the classroom by trained project personnel. All students were asked to provide breath and saliva samples which they were told would be analyzed to determine their smoking status. This physiological pipeline procedure has been well documented as a way to increase the accuracy of self-reported smoking (2, 9). While the physiological pipeline procedure was aimed primarily at increasing the accuracy of reports of cigarette smoking, it is reasonable that it would have encouraged accurate reporting of chewing tobacco usage as well. The initial assessment was completed during the winter of 1982–1983. The follow-up assessment was completed during the fall term of 1983. Parents were sent a postage-paid consent letter which they

were to return if they did not want their child assessed; 4% did so. Since an additional 4% of the subjects also declined to participate, the total declination rate was 8% of the possible sample.

RESULTS

Prevalence and Stability of Smokeless Tobacco Use

Among these adolescents, "snuff-dipping" was the predominant form of smokeless tobacco use. This form of use involves placing a small amount of moist snuff between the mucosa of the cheek or lip and the gums, and leaving it there as long as desired. Since subject responses indicated that smokeless tobacco use is predominantly a male activity, data for females are not presented in detail. At the initial assessment, only 19% of the girls in the study reported ever using smokeless tobacco, and less than 0.5% said that they had used it more than 10 times in the past 6 months.

The data at initial assessment indicated that over 60% of the boys had used smokeless tobacco, with 7% reporting daily use and an additional 4% having used it 10 or more times in the past 6 months. These prevalence rates are shown in the far right column of Table 1. Responses to several questionnaire items provided data with which to categorize the boys into five groups, on the basis of their current or past use of chewing tobacco. The number and percentage of boys in each category who responded at both initial assessment and 9-month follow-up are shown in Table 1.

Table 1 reveals a moderate degree of stability in smokeless use over the 9-month study period. Of the original never users, only 1% became daily users at follow-up, and 84% remained nontriers. Of the initial daily users who were reassessed at follow-up, 71% continued their regular use of smokeless tobacco. The other three categories were less stable, perhaps due to their representing more subtle distinctions.

Initial Experience with Smokeless Tobacco

Among boys who reported any use, the mean age for the first use of smokeless tobacco was 11.2 years. Most (59.9%), reported that their initial smokeless tobacco experience took place in the presence of a male peer(s). An additional 21.3% indicated that they were with an older boy(s), while 5.3% responded that they were with a younger boy(s). Therefore, 86.1% report that their first smokeless tobacco experience occurred in the presence of other boys. Only 6.2% of the boys' first smokeless tobacco experiences reportedly occurred with a girl present. Adults were said to be present in about 21% of the initial smokeless tobacco incidents. Only 4% of boys reported that they were alone when they first used smokeless tobacco.

When asked how they acquired the smokeless tobacco used in the first instance, 44.4% of boys reported that it was given to them by a same-age peer. An additional 19.7% reported that it was given to them by an older teen, while only 4.7% reported that it had been acquired from a young teen. Taken together, 68.8% of the subjects reported that they had acquired their first smokeless tobacco from

TABLE 1
CONCURRENT AND LONGITUDINAL USE OF SMOKELESS TOBACCO BY MALE ADOLESCENTS

Use of smokeless tobacco at initial assessment	Use of smokeless tobacco at 9-month follow-up assessment					Initial assessment totals for longitudinal subjects only	Initial assessment totals for all subjects
	Never used	Tried more than 6 months ago	Used ≤ 10 times in last 6 months	Used > 10 times in last 6 months	Use daily		
Never used	363 (84%)	62 (14%)	—	—	6 (1%)	431 (38%)	583 (39%)
Tried more than 6 months ago	31 (9%)	205 (59%)	90 (26%)	20 (6%)	4 (1%)	350 (31%)	468 (31%)
Used ≤ 10 times in last 6 months	6 (3%)	89 (40%)	86 (38%)	30 (13%)	14 (6%)	225 (20%)	287 (19%)
Used ≥ 10 times in last 6 months	—	2 (4%)	20 (43%)	10 (22%)	14 (30%)	46 (4%)	62 (4%)
Use daily	—	2 (4%)	11 (16%)	6 (9%)	47 (71%)	66 (6%)	98 (7%)
Total	400 (36%)	362 (32%)	207 (18%)	66 (6%)	86 (8%)	1,118 (100%)	1,498 (100%)

other teens. Adults reportedly gave the first smokeless tobacco to 19.8% of the boys, while only 6.4% indicated that they had bought it. The average age of first purchase was 11.4 years (16 is the legal age for such purchases). An additional 3% responded that they stole it, and 2.6% said that they had found their first smokeless tobacco.

Usage Patterns among Daily Users

Patterns of use among male adolescents who reported daily use of smokeless tobacco were examined. Of these daily users, 71% were under the legal purchase age in the state of Oregon, with a mean age of 14.7 years. These daily users reported that they had started using smokeless tobacco regularly at about 12 years of age, (SD = 2.6) and had been regular users for a mean of 2.8 years. Over 91% of these subjects identified brands of moist snuff as their usual brand of smokeless tobacco. The boys indicated that a can or tin of smokeless tobacco lasts a mean of 5.1 days (SD = 3.3) and that they use a mean of 5.3 chews (SD = 3.2) each day. Since each can of smokeless tobacco contains 34.02 g (1.2 ounces) of tobacco, a rough estimate of "dip size" used by these adolescents can be obtained by dividing this weight by the number of dips per can. This yields an average reported dip size of 1.3 g (0.06 ounces). When asked how long they usually keep the tobacco in their mouth, 58.2% reported 10 to 20 min, 33.7% indicated more than 20 min, and 8.2% responded less than 10 min. On average, then, the adolescent male daily user takes 5.3 dips of about 1.3 g each day, and keeps it in his mouth for 10 to 20 min.

Regarding the perceived health risks associated with smokeless tobacco use, 30.6% of the daily users agree with the statement that "there is very little health risk from chewing tobacco." A significantly smaller proportion of the other subjects (16.5%) agree with that statement [$\chi^2(1) (n = 1,498) = 11.7, P < 0.001$].

Concurrent Correlates of Smokeless Tobacco Use among Boys

Concurrent use of smokeless tobacco and other drugs. For the full sample of boys, the percentages reporting smoking in the last week, pot smoking in the past week, and having at least one drink of alcohol in the last week were 10.2, 15.6 and 35.5%, respectively. Of those reporting use of these substances, 42.6% indicated that they used more than one substance. Among subjects who indicated daily use of smokeless tobacco, 82.7% report use of multiple substances. Interestingly, the use of smokeless tobacco among boys was greater than that of cigarettes, with 18.8% reporting use of smokeless tobacco in the last 6 months, 10.4% indicating use of cigarettes, and 11.1% reporting use of both substances. The pattern was similar for heavier use, with 5.7% indicating daily use of smokeless tobacco, 3.5% reporting daily cigarette use, and 0.9% indicating daily use of both substances. Multiple drug use among daily smokeless tobacco users was high, with 21.4% also reporting smoking in the last week, 40.8% using marijuana in the last week, and 75.5% using alcohol in the last week.

As shown in Table 4, the percentage of students reporting smoking cigarettes, consuming alcohol, and smoking marijuana consistently increases as a function of increasing current use of smokeless tobacco. The smokeless tobacco use catego-

ries were significantly associated with cigarette smoking ($\tau\text{-c} = 0.284$), with marijuana use ($\tau\text{-c} = 0.210$), and with alcohol consumption ($\tau\text{-c} = 0.354$). When these associations were examined separately for middle and high school students, there was little difference in the relationships.

The uses of chewing tobacco, cigarettes, marijuana, and alcohol were significantly interrelated. Use of cigarettes in the previous 6 months was associated with use of marijuana ($\phi = 0.359$) and alcohol ($\phi = 0.266$) in the last week. Use of marijuana in the last week was significantly related to alcohol consumption in the last week ($\phi = 0.379$).

It is of interest to compare prevalence rates of smoking and smokeless tobacco for boys and girls. In this sample, 13.5% of the girls reported smoking in the last week, compared with 10.2% of boys. However, if one combines the students who report only smoking in the last week with those who report daily use of smokeless tobacco, the combined tobacco use for boys was 19% (including 2.6% who report both daily chewing and smoking in the last week). The combined tobacco use for girls was 14.7%.

Factors related to smokeless tobacco use among boys. Stepwise discriminant analysis procedures were employed to define the function which best discriminated between boys who reported using smokeless tobacco in the last 6 months and those who did not. The boys were split into two random samples to determine whether separate analyses of the two subject groups would yield similar conclusions. As listed in Table 2, the questionnaire items used in the analysis included sets of items exploring smokeless tobacco modeling and beliefs, subject cigarette use, peer and parent cigarette use, and subject use of other drugs.

The results of the split-sample analyses are displayed in Table 2. The analyses indicated that considerable discriminating power was present in the variables being employed. That is, significant Wilks' λ of 0.66 and 0.71 were found, and the shared or explained variances were 34 and 29%, respectively. In both samples the derived functions correctly classified about 80% of the subjects. The structure coefficients (i.e., the correlations between the predictor variables and the discriminant score for each subject) indicated that the items that asked about the "number of friends that chew" and asked "does your best friend chew?" were highly related to the discriminant function, and thus discriminated between users and nonusers. When entered last in the discriminant function, both of these variables significantly increased the distance or separation between the groups (i.e., yielded a significant change in Rao's V , a generalized distance measure). This finding replicated across samples and is consistent with studies of adolescent cigarette smoking (1). As shown in Table 2, a similar analysis to discriminate between male adolescents who use smokeless tobacco daily ($N = 98$) and those who have never used it ($N = 583$) explained 58% of the variance and correctly classified 93% of the subjects. Again, peer use of smokeless tobacco was the primary discriminating variable.

Factors related to trying smokeless tobacco among boys. Another important issue in smokeless tobacco research involves the identification of the factors that discriminate between boys who try smokeless tobacco and those who do not. The identification of such factors might be useful in the prevention of onset. The results of split-sample discriminant analyses to distinguish between boys who re-

ported that they had tried smokeless tobacco and those who did not are presented in Table 3. The analyses yielded significant Wilks' λ of 0.70 and 0.74. The resulting discriminant functions explained 30 and 26% of the variance, respectively, and correctly classified more than 74% of the subjects. The variables that were highly related to the discriminant functions were subject's having "tried smoking," "peer use of smokeless tobacco," and subject's "intention to smoke." Both "tried smoking" and "peer use of smokeless tobacco" accounted for a significant increment in group separation (i.e., Rao's V) after all other variables had been entered into the discriminant function.

Those variables found to have significant structure coefficients in either of these concurrent analyses were cross-tabulated with smokeless tobacco use categories and are presented in Table 4. The strong relationship between peer and subject use of smokeless tobacco is evident, with Kendall τ -c of 0.429 and 0.481 for best friend use of smokeless tobacco and one or more friends' use.

Prospective Predictors of Smokeless Tobacco Use

Predictors of smokeless tobacco onset. The identification of prospective factors related to both onset (initial trying) and change in usage is an important problem in understanding adolescent substance use. A discriminant analysis to predict the onset of smokeless tobacco use among subjects who had never used it at baseline was performed. While the derived discriminant function correctly classified 85% of the subjects and yielded a significant Wilks' λ ($P < 0.0001$), only about 11% of the variance was explained. The structure coefficients suggest that having "tried smoking," "peer and sister smoking," "subject marijuana use," and "best friend using smokeless tobacco" are related to onset.

Predictors of change in smokeless tobacco use. Change in usage over time was examined by tracking smokeless tobacco use among daily users at baseline. Given that only 66 of the 98 reported daily users at initial assessment provided data at the 9-month follow-up, the results of this analysis may reflect some sample bias. Regression analysis was employed to predict "number of smokeless tobacco uses per day" at follow-up from variables measured at the initial assessment. In an effort to maintain a more reasonable subject-to-variable ratio, the original 22 variables were reduced to 8, representing number of uses per day, extent of peer smokeless tobacco use, extent of family smokeless tobacco use, intention to smoke, subject smoking in last 6 months, extent of peer smoking, extent of family smoking, and subject use of marijuana and alcohol. Two of these variables were significantly related to follow-up smokeless tobacco use rate: number of smokeless tobacco uses per day at initial assessment ($r = 0.576$, $P < 0.001$) and use of marijuana and alcohol ($r = 0.221$, $P < 0.037$). In the regression analysis, the marijuana and alcohol composite did not account for significant additional variance after baseline smokeless tobacco use rate had been entered into the regression equation. Consequently, only initial smokeless tobacco use rate entered the final regression equation, and it accounted for 33% of the variance in follow-up smokeless tobacco use rates ($R^2 = 0.33$).

Smokeless Tobacco Use as Predictor of Other Drug Use

Male adolescents who had used smokeless tobacco in the previous 6 months

TABLE 2
CONCURRENT ANALYSIS OF USE OF SMOKELESS TOBACCO AMONG MALE ADOLESCENTS

Predictor variable	Use of smokeless tobacco in last 6 months				Daily use vs never use Sample not split ^c	
	Split sample A ^a		Split sample B ^b		Standardized coefficient	Structure coefficient
	Standardized coefficient	Structure coefficient	Standardized coefficient	Structure coefficient		
Best friend uses	0.47	0.72	0.47	0.73	0.63	0.74
No. of friends users	0.60	0.81	0.41	0.70	0.31	0.58
Father uses	—	—	—	—	0.17	—
No. brothers uses	—	—	0.10	—	0.06	—
Beliefs for chewing risks	-0.11	—	-0.20	—	-0.08	—
Tired smoking	0.24	0.31	0.28	0.45	0.21	—
Intention to smoke	0.01	0.37	—	—	—	—
No. cigarettes last week	-0.29	—	-0.12	—	—	—
No. cigarettes yesterday	0.32	—	—	—	-0.02	—
Smoking last 6 months	0.01	0.30	0.24	0.40	0.28	0.34
No. offers to smoke last week	-0.08	—	—	—	—	—
No. cigarette offers accepted last week	—	—	—	—	-0.19	—

Best friend smokes		-0.18			-0.16	
No. of friends smokers		--			-0.07	
Father smokes	0.02	--			--	
Mother smokes	--	--			--	
No. brothers smoke	--	--			--	
No. sisters smoke	--	0.12			0.08	
No. smoked marijuana last week	--	--			-0.07	0.32
Use marijuana daily	0.18	--			0.30	--
No. alcoholic drinks last week	0.06	0.22	0.40		0.30	0.42
Drink alcohol daily	--	--	--		0.09	--
Total Wilks' λ	0.66		0.71		0.42	
Significance of λ	P < 0.0001		P < 0.0001		P < 0.0001	
Canonical correlation	0.58		0.54		0.76	
Explained variance	0.34		0.29		0.58	
Group 1 centroid	-0.47		-0.42		-0.48	
Group 2 centroid	1.09		0.99		2.85	
% Correct classification						
For sample A overall	80		79		93	
For sample B overall	76		79			
For group 1 of analysis sample	89 ^a		89 ^b		94 ^c	
For group 2 of analysis sample	60		54		86	

^a Total $N = 740$: group 1 = no use in last 6 months ($N = 520$); group 2 = used in last 6 months ($N = 220$).

^b Total $N = 756$: group 1 = no use in last 6 months ($N = 531$); group 2 = used in last 6 months ($N = 225$).

^c Total $N = 681$: group 1 = never used ($N = 583$); group 2 = use daily ($N = 98$).

TABLE 3
CONCURRENT DISCRIMINANT ANALYSIS OF TRYING SMOKELESS TOBACCO
AMONG MALE ADOLESCENTS

Predictor variable	Split sample A ^a		Split sample B ^b	
	Standardized coefficient	Structure coefficient	Standardized coefficient	Structure coefficient
Best friend uses	0.42	0.57	0.16	0.50
No. of friends uses	0.32	0.58	0.39	0.58
Father uses	—	—	—	—
No. brothers uses	—	—	—	—
Beliefs for chewing risks	—	—	—	—
Tried smoking	0.56	0.64	0.63	0.75
Intention to smoke	0.15	0.40	0.36	0.50
No. cigarettes last week	—	—	—	—
No. cigarettes yesterday	—	—	—	—
Smoking last 6 months	0.18	0.42	—	—
No. offers to smoke last week	-0.02	—	0.26	—
No. cigarette offers accepted last week	-0.10	—	-0.36	—
Best friend smokes	-0.26	—	-0.03	—
No. of friends smokers	0.14	0.34	—	—
Father smokes	-0.08	—	0.10	—
Mother smokes	—	—	—	—
No. brothers smoke	—	—	—	—
No. sisters smoke	0.15	—	—	—
No. marijuana smoked last week	0.06	—	—	—
Use marijuana daily	-0.01	—	—	—
No. alcoholic drinks last week	0.12	0.34	0.10	0.33
Drink alcohol daily	—	—	—	—
Total Wilks' λ	0.70		0.74	
Significance of λ	$P < 0.0001$		$P < 0.0001$	
Canonical correlation	0.55		0.51	
Explained variance	0.30		0.26	
Group 1 centroid	-0.80		-0.76	
Group 2 centroid	0.53		0.46	
% Correct classification:				
For sample A overall	75		74	
For sample B overall	74		73	
For group 1 of analysis sample	56 ^a		53 ^b	
For group 2 of analysis sample	87		87	

^a Total $N = 742$; group 1 = never used ($N = 297$); group 2 = used in lifetime ($N = 445$).

^b Total $N = 756$; group 1 = never used ($N = 286$); group 2 = used in lifetime ($N = 470$).

but were not currently using other drug substances were at increased risk to begin use of those substances. Given that a subject was not using cigarettes at baseline, he was more likely to be smoking at follow-up if he was already using smokeless tobacco. The proportion of subjects initiating cigarette smoking was 22.4% ($N = 49$) for smokeless tobacco users and 7.3% ($N = 54$) for nonusers [$\chi^2(1) (N = 955) = 38.1, P < 0.0001$]. The same predictive relationships held regarding the onset of marijuana and alcohol use. That is, 17.6% ($N = 46$) of smokeless tobacco users took up use of marijuana while only 7.1% of the nonusers did so [$\chi^2(1) (N =$

TABLE 4
PERCENTAGE OF MALE ADOLESCENTS IN EACH SMOKELESS TOBACCO USE CATEGORY FOR VARIABLES RELATED TO USE

Concurrent correlates	Never used smokeless (<i>N</i> = 583)	Categories of smokeless use			Daily user (<i>N</i> = 98)	Kendall's τ -c
		Experimenter (<i>N</i> = 468)	≤ 10 uses in last 6 months (<i>N</i> = 287)	> 10 uses in last 6 months (<i>N</i> = 62)		
Percentage reporting best friend uses	7.7	18.3	43.5	63.9	80.2	0.429
Percentage reporting one or more friends who use	21.9	41.0	67.8	94.6	94.0	0.481
Percentage reporting intention to smoke	5.0	17.4	19.9	21.0	23.5	0.149
Percentage reporting having tried smoking	45.5	80.5	85.0	82.3	91.8	0.384
Percentage reporting one or more cigarettes in last 6 months	6.7	24.9	33.9	45.2	41.8	0.284
Percentage reporting one or more friends who smoke	20.8	38.1	42.7	50.0	49.5	0.229
Percentage reporting use of marijuana in last week	5.0	17.8	22.3	25.8	40.8	0.210
Percentage reporting smoking marijuana daily	0.9	3.0	4.2	4.8	16.8	0.062
Percentage reporting one or more drinks in last week	19.6	36.3	47.1	72.6	75.5	0.354

Note. χ^2 statistic is significant for all ($P < 0.001$).

1,053) = 23.5, $P < 0.0001$], and 37.1% ($N = 58$) of smokeless tobacco users adopted use of alcohol but only 17.9% of the nonusers initiated use of alcohol [χ^2 (1) ($N = 799$) = 31.7, $P < 0.001$]. The strength of the relationship for cigarettes, marijuana, and alcohol was consistent, with ϕ statistic values of 0.204, 0.153, and 0.203, respectively. A smokeless tobacco user was at significantly greater risk to begin use of cigarettes, marijuana, and alcohol.

The data were also examined to determine whether the use of smokeless tobacco at initial assessment predicted increased use of cigarettes, marijuana, and/or alcohol at follow-up for male adolescents. The data again indicate a consistent pattern across the three substances. While 18.4% of the smokeless tobacco users at initial assessment reported increased use of cigarettes in the last week at follow-up, only 7.5% of the nonusers of smokeless tobacco increased their use of cigarettes [χ^2 (1) ($N = 1,193$) = 29.3, $P < 0.0001$]. For marijuana, 19.8% of the smokeless tobacco users reported increased use in the last week, compared with 8.3% of the smokeless tobacco nonusers [χ^2 (1) ($N = 1,221$) = 30.8, $P < 0.0001$]. Lastly, 34.4% of the smokeless tobacco users reported increased use of alcohol in the last week, compared with 20.2% of the nonusers [χ^2 (1) ($N = 1,200$) = 26.2, $P < 0.0001$]. The ϕ statistics for cigarettes, marijuana, and alcohol were 0.160, 0.163, and 0.150, respectively. In sum, male adolescent smokeless tobacco users were significantly more likely to increase use of cigarettes, marijuana, and alcohol than were nonusers.

DISCUSSION

Patterns of Use

The finding that smokeless tobacco use is very much a male activity clearly replicates both our own work and that of others (5, 15, 17, 21). For adolescent boys, the initial experience with smokeless tobacco appears to occur predominantly in a social context with other male adolescents, which is very similar to findings on initial cigarette smoking episodes (10). Interestingly, only 3% report that they stole the smokeless tobacco they used in this initial experience, while 36% of adolescents who have smoked report that they stole their first cigarette (10). In the current study, 6.4% indicate that they purchased the smokeless tobacco that they first used, although none of these subjects was old enough to purchase it legally. These findings suggest that smokeless tobacco may be purchased more readily by adolescents than are cigarettes.

Smokeless tobacco use patterns among daily users reflect a good deal of variability across individuals. The average reported use rate was 5.3 dips of moist snuff per day of about 1.3 g each. Since moist snuff contains 12.9 to 16.6 mg of nicotine per gram (13, 16), and these subjects reportedly use about 6.9 g each day, they are exposed to roughly 89 to 114 mg of nicotine per day. Cigarette tobacco averages 9 mg nicotine per cigarette (3). Thus, a person smoking about 10 to 13 cigarettes per day would be exposed to similar amounts of nicotine. Because the method of nicotine delivery is different for smokeless tobacco and cigarettes, the absorption, distribution, and plasma concentrations of nicotine will differ. Nonetheless, it appears that substantial nicotine exposure through use of smokeless

tobacco occurs among a sizable proportion of male adolescents. Research efforts addressing the topography of adolescent smokeless tobacco use and the pharmacokinetics of nicotine in smokeless tobacco would serve to clarify the extent to which nicotine dependence resulting from the use of smokeless tobacco is a drug-abuse problem.

Concurrent Correlates

In this study, male adolescent users and nonusers of smokeless tobacco were reliably categorized by means of the discriminant function analyses. The strongest contributors to the discriminant function were smokeless tobacco use by one's best friend and the number of friends using smokeless tobacco. The split-sample cross-validation procedure demonstrated the stability or replicability of these analyses. It is notable that neither father's smokeless tobacco use nor parental smoking was significantly related to smokeless tobacco use by these boys.

The split-sample procedure was also used to develop discriminant functions for triers vs never triers of smokeless tobacco. Once again, peer use of smokeless tobacco was a major contributor to the discriminant function, but whether the subject had tried smoking was an even stronger contributor. "Intention to smoke" also had a sizable structure coefficient.

In sum, the initial smokeless tobacco experience appears to be quite similar to the initial smoking experience, generally occurring in a social context among peers. In addition, the finding that peer use of smokeless tobacco is an important factor in discriminating smokeless tobacco users from nonusers underscores the peer social influence process in the development of smokeless tobacco use and is quite consistent with data on cigarette smoking (1). It seems reasonable to expect that the school-based smoking prevention curricula that emphasize social skills to resist peer pressure might generalize well when modified to address smokeless tobacco onset and use.

In addition, the finding that a significant proportion of daily users of smokeless tobacco perceive little health risk from smokeless tobacco use suggests that prevention efforts might usefully include a knowledge-based component to address this problem.

Prospective Predictors

The 9-month follow-up data indicate considerable stability in the use of smokeless tobacco: 71% of the original daily users continued to chew daily and, conversely, only 1% of the boys shifted from never users to daily users. Prospective prediction of onset (i.e., the trying of smokeless tobacco among adolescents who had never used it previously) was not very successful. Within this limitation, it is interesting that subject smoking variables, peer and sibling smoking, and marijuana use were the strongest contributors to the discriminant function. In the prospective analyses of the rate of daily smokeless tobacco use among daily users, initial use rate was the best predictor of smokeless tobacco use rate at

follow-up. While the number of subjects is small and replication is clearly needed, this finding is consistent with similar analyses involving adolescent cigarette smoking in which the best predictor of follow-up smoking rate was pretest smoking rate (1).

Multiple Drug Use

In this study, the use of smokeless tobacco was found to be associated with concurrent use of other substances among adolescent males. A significant proportion (42%) of male adolescents reported use of one of the following: daily use of smokeless tobacco, use of cigarettes in the last week, use of marijuana in the last week, or use of alcohol in the last week. Of those who reported some use of these substances, 43% indicated multidrug use. Hunter *et al.* (15) found a similar relationship. It appears that daily users of smokeless tobacco are especially likely to also be using cigarettes, marijuana, or alcohol, with 83% reporting that they do so. It is particularly noteworthy that 76% of the self-reported daily users of smokeless tobacco had also consumed alcohol in the last week.

Evidence was also presented indicating that boys who use smokeless tobacco are at greater risk for cigarette and marijuana use or alcohol consumption at follow-up than are nonusers. Similarly, smokeless tobacco users who reported cigarette, marijuana, and/or alcohol use were more likely to increase their use of these other substances than were subjects who were not smokeless tobacco users.

In sum, among male adolescents, multiple drug use is common, and among daily users of smokeless tobacco, multiple use is the norm. The use of smokeless tobacco is a risk factor for the onset and/or increased use of cigarettes, marijuana, and alcohol. These findings are consistent with a multiple drug use model of adolescent "problem behavior" (8).

Study Limitations

As with most studies, this investigation has some limitations. The primary limitation is that the findings are based on questionnaire self-report measures which may be subject to response bias. Physiological pipeline procedures involving the collection of both breath and saliva samples were employed, however, and may have enhanced the validity of these self-report measures. The generalizability of these findings might also be somewhat limited. While the sample studied was reasonably large, it was drawn from four school districts in one state. In addition, there is some evidence that students who decline to participate in such studies are more likely to be drug users (20). It seems that the unbiased use rates for these substances might be somewhat higher than reported here. It is unclear whether and how the correlates of use might differ with inclusion of the declining subjects.

FUTURE DIRECTIONS

It would be prudent for future research efforts to adopt a multimethod approach to measurement by including face-to-face interviews, phone interviews,

self-monitoring, direct observation, and corroboration by significant others, in addition to questionnaire self-reports. The replication and convergence of findings based on these differing methods would enhance our confidence in their validity. Because little is known about how and when adolescents (or adults) use smokeless tobacco, research addressing the topography of use and careful study of the situations in which use occurs would contribute to our understanding of the behavior and would provide the knowledge base necessary to develop appropriate prevention and cessation interventions. In addition, efforts to enhance our understanding of the physiological, pharmacological, and addictive effects of smokeless tobacco use would provide a better assessment of the nature and extent of the problem.

The degree to which smokeless tobacco use provides a transition to cigarette smoking is a critical issue in the prevention of cancer and cardiovascular disease. Multimethod longitudinal research with adolescent smokeless tobacco users is needed to address this issue. Many adolescent boys may develop a nicotine habit using smokeless tobacco while quite young, attracted in part by its availability and the ability to use the drug unobtrusively in the school environment. As these boys grow older, it often becomes clear that the use of the substance is socially unacceptable, particularly to dating-age girls. This situation may lead to the substitution of cigarette smoking to meet their established nicotine needs. Effective intervention and cessation efforts directed at this transition process may serve to substantially reduce the number of smokers. The related transition from use of smokeless tobacco to use of marijuana and alcohol may be just as central to the prevention of drug abuse in a general sense. More information about these "gateway" transition processes is critical to the development of effective intervention programs.

Preventive measures for adolescent smokeless tobacco use might include the development and evaluation of school-based prevention programs patterned after current smoking prevention curricula (22), which include components focusing on refusal skills training, the health consequences of use, the elicitation of a public commitment not to use, the involvement of parents, the use of telephone hotlines, and schoolwide activities such as contests and "quit" days. An integrated curriculum aimed at the prevention of both smokeless tobacco use and cigarette smoking would be appropriate.

Additional preventive measures might include office-based interventions involving physicians and especially dentists, and smokeless tobacco cessation clinics patterned after smoking cessation clinics. As noted above, adolescents lack knowledge about the health consequences of smokeless tobacco use. Information about long-term and especially short-term effects could be useful (11). Dentists and oral hygienists are in a unique position to observe the short-term effects of smokeless tobacco use and to point these out to their patients. It is important to emphasize, however, that all smokeless tobacco cessation programs should include components designed to forestall the onset or increased use of cigarettes as a substitute source of nicotine.

The apparent accessibility of smokeless tobacco at an early age, the fact that it

can be used unobtrusively, and the perception that it is harmless suggest that smokeless tobacco will be the first addictive drug used by a substantial number of males. Among adolescent males, smokeless tobacco use may function as a gateway to the use of other drugs.

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