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Situational Factors and Patterns Associated with Smokeless Tobacco Use

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Situational factors and topographic features associated with smokeless tobacco use were examined. Male smokeless tobacco users (N = 30) were asked to record the time, activity, and internal states associated with each dip of tobacco use over the course of 10 days. Additionally, these subjects were asked to record the activity and internal state they were experiencing every hour for a 15-hr waking period to obtain baseline rates of these events. Serum and saliva samples were obtained to measure cotinine concentrations. The activities significantly associated with smokeless tobacco use included after a meal, while driving, and while watching television. The internal states associated with smokeless tobacco use were feeling relaxed and depressed. Factor analysis of the events showed factors which are different from those found among cigarette smokers. Examination of the topographic measures of smokeless tobacco use showed that the total dip duration per day was 283.5 min, with a range of 79.7–757.1 min. This measure, along with duration of dipping time (time from onset to offset of smokeless tobacco use during the day), may be the best predictors of nicotine exposure.

KEY WORDS: smokeless tobacco; topography; situational events.

INTRODUCTION

There are approximately 12 million smokeless tobacco users in the United States. The production of smokeless tobacco products has increased

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by 40% since 1970 (U.S. Department of Health and Human Services, 1986), which indicates an increase in the number of new users. This increase is of concern since significant medical consequences of smokeless tobacco use have been identified which include oral pathologies such as leukoplakia, cancer, and gingival recession (Connolly *et al.,* 1986). Furthermore, there is strong evidence suggesting that regular use of smokeless tobacco causes physical dependence (Hatsukami *et al.,* 1987). In spite of these concerns, there has been minimal information on the behavioral factors associated with smokeless tobacco use. For example, no study has prospectively examined situational and internal factors associated with smokeless tobacco use (National Cancer Institute, 1989). It is thus unclear whether smokeless tobacco users use smokeless tobacco in specific situations (after meals, first thing in the morning, when working, etc.) or during times of stress, relaxation, or boredom. Previous research of these factors in cigarette smokers has been useful in the development of cigarette smoking cessation programs which address ways to deal with these situations and internal events without resorting to the use of cigarettes (Pechacek, 1979; Best and Hakstian, 1978). Therefore, understanding the factors associated with smokeless tobacco use would be important in the development of a treatment program for this area.

Another relatively unexplored aspect is the topography of smokeless tobacco use. With one exception (Hatsukami *et al.,* 1988), no study has systematically examined the pattern of smokeless tobacco use and how this pattern relates to levels of nicotine exposure. The present study examines (1) the activities and internal states associated with smokeless tobacco use, (2) the pattern of smokeless tobacco use, and (3) the relationship between serum and saliva cotinine concentrations with topographical measures of smokeless tobacco use.

METHOD

Procedure

Male subjects were recruited from advertisements in the campus and metropolitan newspapers. Subjects were included in the study if they used at least one tin of Copenhagen smokeless tobacco per week for a period of at least 6 months and did not use forms of tobacco or nicotine other than smokeless tobacco. Subjects who were currently experiencing alcohol or drug abuse problems [as defined by DSM III (American Psychiatric Association, 1980)], who had a psychiatric diagnosis, or who were taking psychoactive medications were excluded from the study.

Smokeless tobacco use was monitored for 10 consecutive days in the natural environment. Subjects were required to attend five laboratory sessions during those 10 days. For all subjects, testing began on Monday of the first week and ended Wednesday of the following week. All laboratory visits were scheduled at the same time of day in the late afternoon.

On the first day (Monday), subjects came to the laboratory and were given information regarding the procedures of the study, and informed consent was obtained. Subjects were shown how to complete the Smokeless Tobacco Diary (see below). Subjects were asked to record the time, activity, and internal state associated with each "dip" of smokeless tobacco for the next 10 days. In addition, subjects were asked to record the activity and internal state they were experiencing every hour for a 15-hr waking period during 7 of those 10 days. The subjects were given beepers programmed to emit a tone every hour during a 15-hr period to remind them to record these events. This procedure was used to obtain baseline rates of each activity and internal state. Concurrent recordings of events associated with each dip and with each hour of the day were employed since pilot study data showed no effect of this procedure on the number of dips recorded. Subjects were also asked to expectorate each dip for 7 of the 10 days and to save the expectorates in separate, marked plastic bags. Subjects were issued a supply of smokeless tobacco to use until the next laboratory session. Subjects were asked to return to the laboratory on Tuesday, Friday, Monday, and Wednesday. At these sessions, subjects were asked to return smokeless tobacco diaries, base-rate activity and internal states diaries, smokeless tobacco expectorates, and used and unused tins of smokeless tobacco. Blood and saliva samples were obtained on the first (Monday) and third session (Friday) to determine serum and saliva cotinine concentrations, respectively.

The serum and saliva samples were analyzed by the Department of Public Health, Division of Epidemiology, at the University of Minnesota. The expectorates were dried in a chemical drying oven at 50°C for 24 hr and weighed. Subjects were paid $100 for compliance with the study procedures plus $25 bonus if everything was *completed.*

Smokeless Tobacco Diary

For each dip of smokeless tobacco, subjects recorded the following in their diary: (1) the time at which the dip of smokeless tobacco was placed in the mouth, (2) the time at which the dip was expectorated, (3) one or more number codes for the activities associated with the onset of the dip, and (4) one or more number codes for the internal states associated with

the onset of the dip. The options for activities and internal states were drawn from previous analyses of cigarette smoking situations (McKennell, 1970; Best and Hakstian, 1978) and from a survey of smokeless tobacco use situations endorsed by subjects in a pilot project in our lab (see Tables II and III). Recording sheets are 4 × 5 in. One side of the sheet lists the number codes for activities and internal states. The other side consists of columns headed Time, Activity, and Feeling (for internal state). Under each of these columns are rows for consecutively entering times and code numbers for 20 dips of smokeless tobacco. In addition to the options offered, subjects were encouraged to write in other activities and internal states which they felt more appropriately described their use of smokeless tobacco. Since the majority of responses requires only the recording of a number, self-monitoring takes only a few seconds once the subjects become familiar with the category options. Subjects were cued to the experimental procedures by the attachment of the recording sheets, which are bright yellow, on their tins of smokeless tobacco.

Subjects used the above recording sheets for all dips of smokeless tobacco placed in their mouth. Subjects were instructed to self-monitor after beginning the use of smokeless tobacco. Epstein and Collins (1977) report that reactive effects of similar self-monitoring procedures among cigarette smokers are minimal when subjects are not motivated to change their smoking patterns.

Data Analysis

The activities and internal states associated with smokeless tobacco use were examined. Paired *t* tests were undertaken to determine significant differences in the rate of endorsement of each activity and internal state associated with smokeless tobacco use versus the baseline (nonuse) rates of the events. The use–baseline differences were then compared with each other using paired *t* tests.

Since previous research has shown individual differences in events associated with cigarette smoking (Epstein and Collins, 1979; Hatsukami *et al.*, 1990), we further examined smokeless tobacco use with principal components factor analyses with varimax rotation of the use–baseline differences. The scree test was used to determine the number of factors to be extracted.

The pattern of smokeless tobacco use was characterized by several measures. These included duration of dipping time, number of dips per week, number of dips per day, interdip interval, total dip duration per day (number of dips/day × duration of each dip), amount of each dip (dry

weight of each dip), and dry weight of tobacco per day (number of dips/day × dry weight of each dip). Pearson correlation coefficients were computed between the topographic measures which assessed smokeless tobacco exposure during the day and both plasma and saliva cotinine levels. For this analysis, the mean values of the topographic measures on days 1 and 2 were examined for correlations with the plasma and saliva cotinine levels from samples obtained on day 3. Multiple regression analyses were performed to determine which of these topographic measures were best able to account for plasma and serum cotinine levels.

RESULTS

Thirty-five subjects were recruited for the study. Five subjects dropped out during the course of the study, resulting in a final sample size of 30 subjects. The mean age of the 30 white male smokeless tobacco users was 20.5 years (SD = 2.3). The mean educational level of these subjects was 13.6 years (SD = 1.5). The self-reported mean number of tins per week was 3.4 (SD = 1.6), and the mean duration of smokeless tobacco use was 4.9 years (SD = 2.5). The mean number of attempts at quitting smoke-

Table I. Activities and Internal States Associated with Smokeless Tobacco Use

Variable	Percentage		t
	Baseline rate of activity	Rate of use associated with activity	
Activity			
After meal	6.0	14.2	5.09***
While driving	4.9	7.1	3.08**
Watching TV	21.9	26.4	3.04**
In class	7.3	4.5	-4.24***
Sports	6.6	4.3	-3.45**
Internal state			
Relaxed	30.5	35.8	3.08**
Depressed	3.6	4.9	2.34*
Tired	24.3	21.3	-2.73**
Hungry	6.6	4.8	-2.41*
Busy	11.1	8.2	-3.28**

*$p < .05$.
**$p < .01$.
***$p < .001$.

less tobacco use was 3.0 (SD = 2.7); only 20% of subjects indicated that they had never made an attempt at quitting.

Situational Factors Associated with Smokeless Tobacco Use

Several activities and internal states were found to be significantly related to smokeless tobacco use (see Table I). The activities which were significantly associated with smokeless tobacco use were after a meal, while driving, and while watching television. Subjects were less likely to use smokeless tobacco while in class and during sport activities. The internal states which were significantly associated with smokeless tobacco use were feeling relaxed and feeling depressed. Subjects were less inclined to use smokeless tobacco when feeling tired, hungry, or busy. The "other" write-in category was not analyzed since the responses were so varied between individuals that no particular situation could be systematically examined.

Of the activities which were significantly associated with smokeless tobacco use, the increment in use after a meal was significantly greater than that while driving ($t = 3.07$, df = 29, $p = .005$). Of the internal states which were significantly associated with smokeless tobacco use, the increment in use while relaxed was greater than that when depressed ($t = 2.30$, df = 29, $p = .03$).)

A factor analysis of activities yielded five factors which accounted for 70% of the variance. The factor loadings are shown in Table II. Positive

Table II. Factor Analysis of Activities

Activity	Factor 1	2	3	4	5
1. Studying	.82[a]	-.06	.09	-.34	-.05
2. Relaxing	.66[a]	-.13	.01	.10	.05
3. Drinking caffeinated beverages	-.02	.48[a]	.19	.26	.15
4. Drinking alcoholic beverages	-.12	.56[a]	.12	-.02	-.04
5. Waiting	-.18	.45[a]	.03	-.50	.06
6. Socializing	-.11	.07	.76[a]	-.30	.08
7. Watching TV	.34	-.63[a]	.46[a]	.03	-.23
8. Walking	-.20	.20	-.06	.77[a]	.05
9. Driving	.07	.18	.02	.19	.96[a]
10. In class	-.39	-.47[a]	.12	-.17	.10
11. Sports activities	-.36	.09	-.17	.00	.27
12. Working	-.28	-.12	-.73[a]	-.24	.12
13. After a meal	.14	.14	.02	.27	-.41

[a]Indicates items which load on a particular factor.

Table III. Factor Analysis of Internal States

Internal state	Factor 1	2	3	4
1. Low, depressed	.68[a]	-.04	.27	-.21
2. Bored	.63[a]	-.35	-.07	-.11
3. Tired	-.39	.65[a]	.09	-.43[a]
4. Hungry	.05	.49[a]	.05	.15
5. Anxious, tense	-.18	.17	.39[a]	.38
6. Exicted	.01	.14	-.16	.53[a]
7. Relaxed	.08	-.68[a]	.31	-.27
8. Angry, irritated	-.08	.01	-.05	.20
9. Happy	-.05	.12	-.97[a]	.19
10. Busy	-.59[a]	-.09	.12	.00

[a]Indicates items which load on a particular factor.

loadings would indicate smokeless tobacco use associated with the activities; negative loadings, with nonuse. Factor 1 consisted of the items "studying" and "relaxing." These can be considered as sedentary activities. Factor 2 included relatively large positive loadings from "drinking alcohol," "drinking caffeine," and "waiting" and negative loadings from "in class" and "watching TV." These items do not lend themselves to any particular classification other than appetitive activities for two of the items. Factor 3 included positive loadings from "socializing" and "watching TV" and a negative loading from "working." This may be interpreted as nonworking interactive activities. Factors 4 and 5 consisted largely of single items: "walking" and "driving," respectively.

Four factors were derived from the analysis of internal states, accounting for 66% of the variance. The factor loadings for internal states are presented in Table III. Factor 1 included positive loadings from "depressed" and "bored" and negative loading from "busy"; this can be considered as a negative low arousal state. Factor 2 included positive loadings from "tired" and "hungry" and negative loadings from "relaxed"; this can be considered as a physiological distressed state. Factor 3 included primarily a negative loading from "happy" and a smaller positive loading from "anxious"; this can be considered another negative psychological state. Factor 4 included a positive loading from "excited" and a negative loading from "tired," indicating a positive high arousal state.

Figures 1 and 2 show the distribution of activity and internal state factor scores associated with smokeless tobacco use, respectively. The wide variability in scores indicates that there are significant individual differences. Figure 3 presents a profile of three subjects for each of the factors for activities and internal states. Case 1 shows that his smokeless tobacco

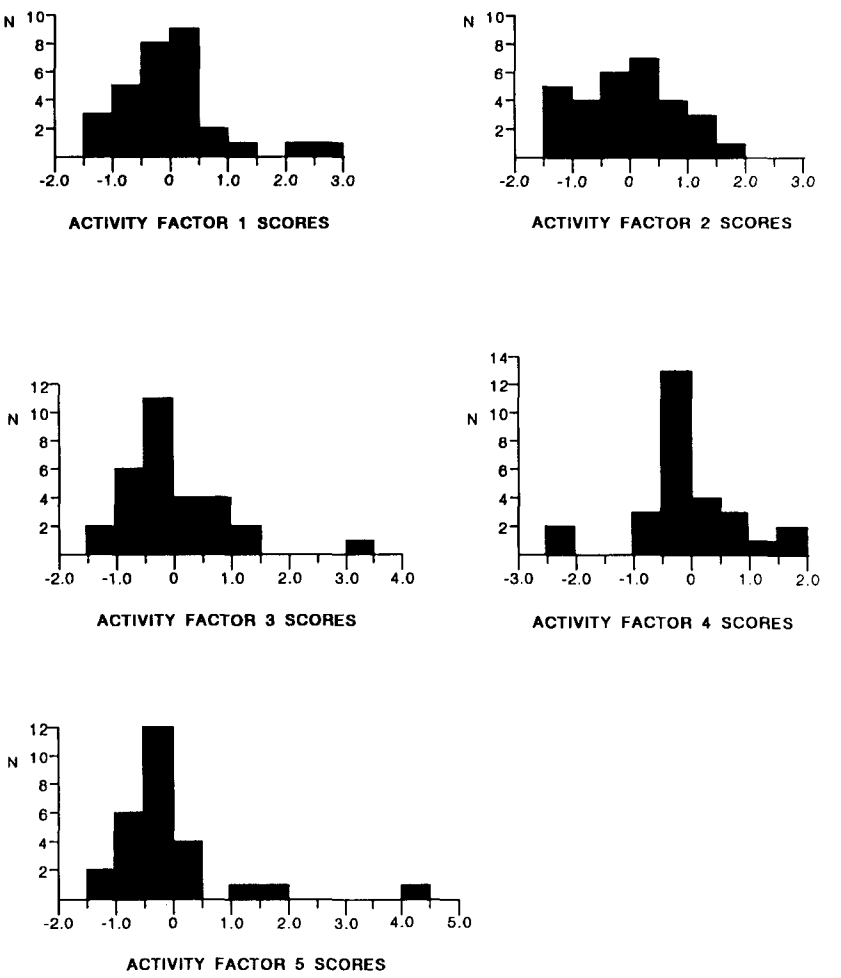

Fig. 1. Distribution of scores across each activity factor.

use is most highly associated with Factor 2 and least associated with Factors 1 and 5, the sedentary activities and driving. On the other hand, case 27 uses smokeless tobacco most in situations that involve sedentary activities, Factor 1, and shows minimal use with Factors 2–5. Case 13 uses smokeless tobacco across all three situations. There are similar individual differences with the internal states factors. Case 26 showed that smokeless tobacco use was associated with Factor 1, feeling depressed or bored, whereas Case 9 showed an opposite association. Case 1 showed minimal association of smokeless tobacco use for these factors.

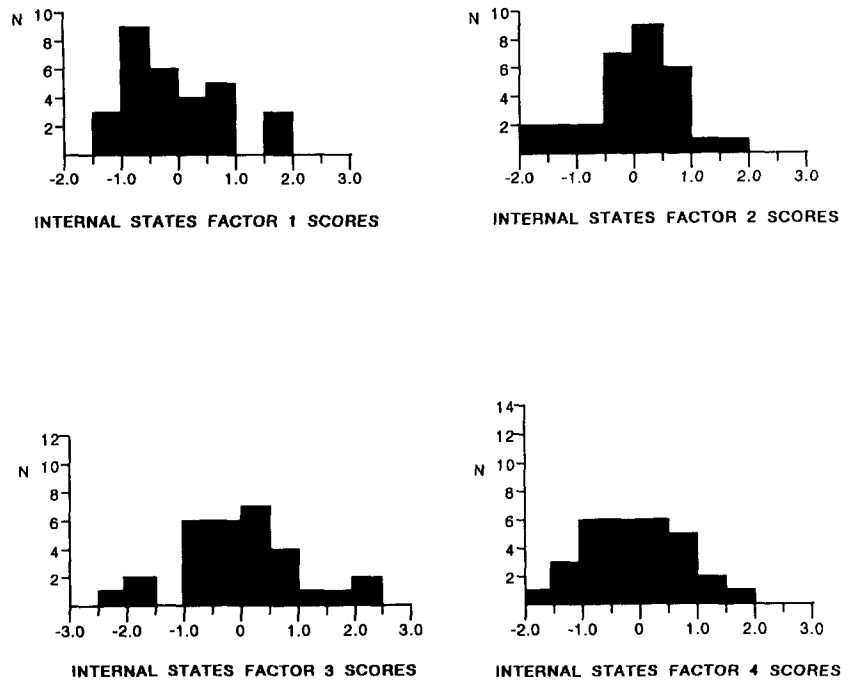

Fig. 2. Distribution of scores across each internal states factor.

Pattern of Smokeless Tobacco Use

The mean time of onset of a dip during the day was 11:03 AM and the mean time of the last dip during the day was 11:08 PM. The mean number of dips per week was 50.9 (SD = 17.8), with a range of 17 to 94 dips/week. The mean dips per day was 7.2 (SD = 2.5), with a range of 2.4–13.4. The mean interdip interval was 71.2 min (SD = 32.2), with a range of 21.3–145.7 min. The mean duration per dip was 39.6 min (SD = 18.3), with a range of 19.1–106.0 min. The mean total dip duration per day was 283.5 min (SD = 149.2), with a range of 79.7–757.1 min. The mean dry weight of tobacco per dip after use was 0.75 g (SD = 0.57), with a range of 0.13–3.12 g, and the mean dry weight of tobacco per day after use was 4.88 g (SD = 2.87), with a range of 0.92 to 11.9 g.

The plasma and saliva samples obtained on the third day of the study were analyzed. The mean (serum) cotinine concentration was 198.3 ng/ml (SD = 109.2), with a range from 26.0 to 509.0 ng/ml. The mean saliva cotinine concentration was 264.2 ng/ml (SD = 110.9), with a range from

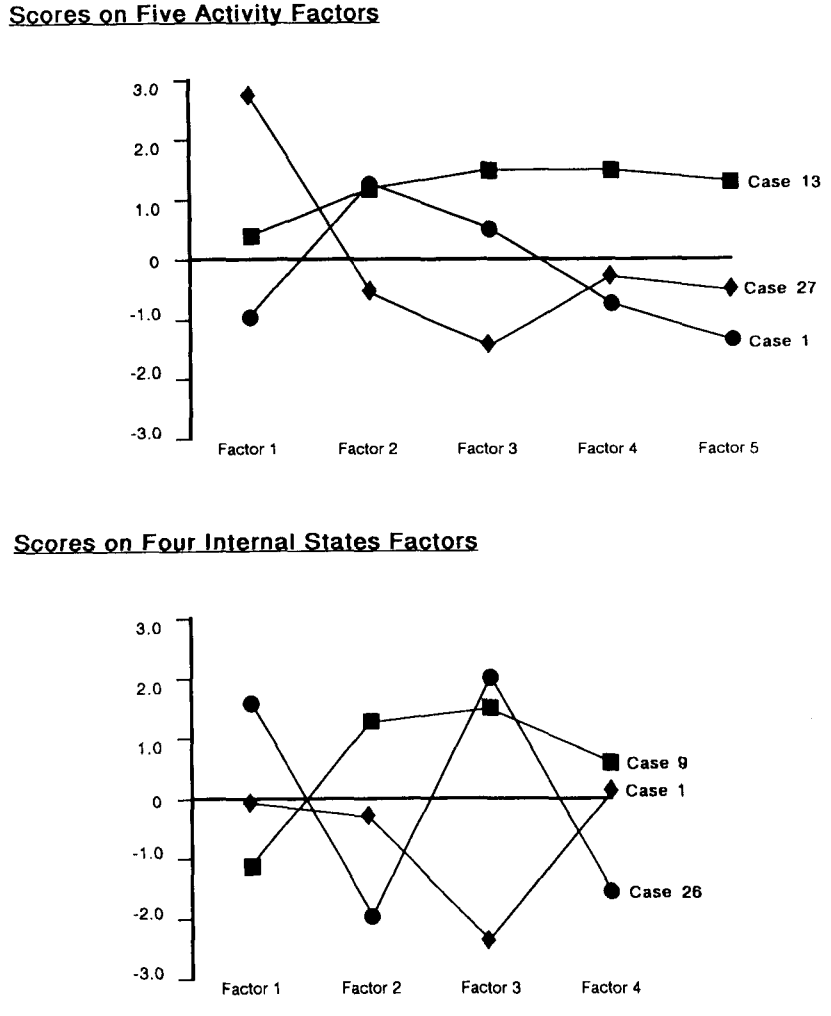

Fig. 3. Profile of activity and internal states factor scores for individual cases.

64.0 to 591.0 ng/ml. These two biochemical measures were significantly correlated ($r = .75, p < .001$). Correlations of each of the biochemical measures with the mean values of the topographic measures of smokeless tobacco use for the previous 2 days are presented in Table IV. Significant positive correlations were found with duration of dipping (time from onset to offset of smokeless tobacco use during the day), number of dips per day, total dip duration per day, and total dip duration × total dry tobacco weight per day.

Table IV. Correlation Coefficient Between Topographical Measures and Serum and Saliva Cotinine Concentrations

	Serum cotinine (N = 29)	Saliva cotinine (N = 30)
Duration of dipping time	.60***	.34
Number of dips/day	.58***	.44*
Total dip duration/day	.66***	.66***
Total dry weight/day	.33	.28
Total dip duration × total dry weight/day	.62***	.47**

*$p < .05$.
**$p < .01$.
***$p < .001$.

With regard to serum cotinine concentration, the model resulting from the regression analysis included two variables: total dip duration per day × total dry weight per day and duration of dipping. The standardized coefficients of these variables (.48 and .45, respectively) indicate that the variables were equally useful in predicting plasma cotinine level. The model yielded an R^2 of .54, indicating that approximately 54% of the variance in plasma cotinine level could be accounted for by a linear relationship with these two variables. With regard to saliva cotinine level, the resulting regression model included only total dip duration per day and yielded an $R^2 = .41$.

DISCUSSION

Situational Factors Associated with Smokeless Tobacco Use

Several interesting findings were observed in this study. First, for the overall analysis, the activities and internal states which were associated with smokeless tobacco use were low arousal in nature (e.g., relaxed, depressed, watching TV, etc.). Furthermore, although the factor analyses highlighted individual variability in smokeless tobacco use, these factors generally involved low arousal states as well. Cigarette smokers, on the other hand, often report increased smoking during high-arousal, particularly negative, as well as low-arousal situations (McKennell, 1970; Best and Hakstian, 1978; Ikard and Tomkins, 1973; Ikard *et al.*, 1969; Coan, 1973). The differences between smokeless tobacco users and cigarette smokers may be accounted for by demographic differences in the two populations. This study specifically examined young college males who use smokeless tobacco. Alternatively, these observed differences may be due in part to pharma-

cokinetics differences between the tobacco products. There has been speculation that smoking patterns differ across situations in order to modulate the stimulant/depressant effects of nicotine. For example, smokers are believed to smoke more in high-arousal situations to obtain a sedating effect and less in low-arousal situations to obtain a stimulant effect (Ashton and Stepney, 1982). Unlike cigarettes, it would be difficult to modulate the immediate effects of nicotine with smokeless tobacco due to its slow absorption rate (Benowitz *et al.,* 1988). Because of this pharmacokinetic property, smokeless tobacco may be used more as a general stimulant than for a precise modulation of mood.

Second, the results were also notable in that sports activities were not frequently associated with smokeless tobacco use, contrary to the findings of a previous survey study (Ary *et al.,* 1989). These conflicting results may be attributable to differences in methodology. This study focused on comparing smokeless tobacco use against base-rate activities. For an example, smokeless tobacco may be perceived as being frequently associated with sports activities, especially in a young active population. However, when compared to base rates, the frequency of smokeless tobacco use during sports activities is actually found to be less than nonuse during these activities.

Third, the relatively frequent use of smokeless tobacco after a meal is also interesting to note since cigarette smokers also report an increased tendency to smoke after meals (McKennell, 1967). The reasons for this frequent association and the potential increase in reinforcing properties of nicotine after a meal are unclear and worth further study.

Finally, another important finding of the study was the large individual differences observed between subjects in the events associated with smokeless tobacco use. Such results indicate the importance of further examining these individual differences in smokeless tobacco users, particularly when discussing treatment.

Patterns of Smokeless Tobacco Use

The topographical features of smokeless tobacco use obtained in the present sample were similar to those observed in a previous prospective study of a comparable age group (Hatsukami *et al.,* 1988). Furthermore, the saliva cotinine concentrations were congruent between the two studies. These levels of cotinine are similar to those obtained from cigarette smokers. Both of these studies, therefore, point to the potential addictive nature of smokeless tobacco. Furthermore, since nicotine increases cardiovascular efforts, the same cardiovascular problems that are attributed to cigarettes

use may also be a consequence of smokeless tobacco use (Benowitz *et al.,* 1989).

The best behavioral measures of the amount of nicotine exposure were total dip duration per day, solely or in conjunction with total dry weight, and total duration of dipping time. Because of the cumbersome nature of obtaining dip weight, the most efficient and least costly method of estimating the amount of nicotine exposure in smokeless tobacco users is either the total dip duration per day or the total duration of dipping time. However, it is notable that these topographic measures only accounted for 54% of the variance.

A few cautionary notes needs to be addressed regarding this study. In this study only smokeless tobacco users without a history of cigarette smoking were examined to maintain a homogeneous sample. However, a significant percentage of smokeless tobacco users have also smoked cigarettes (e.g., Peterson *et al.,* 1989; Riley *et al.,* 1989; Schinke *et al.,* 1986). Therefore, the results from this study may be generalizable to only a segment of the smokeless tobacco using population. Similarly, our sample was limited to white males. Evidence exists indicating race/ethnic and gender differences in smokeless tobacco use (Riley *et al.,* 1990), pointing to the importance of examining situational factors and patterns of use across different ethnic/racial groups. This study also examined only *adult* males. Previous survey studies have shown that male adolescents use smokeless tobacco less frequently and for slightly smaller durations (Ary *et al.,* 1987, 1989).

In summary, the results show that specific events are associated with smokeless tobacco use which may be different from those for cigarette smokers and that clear individual differences exist. Therefore, future behavioral treatment studies in the smokeless tobacco area must take these differences into account. Furthermore, the results show that smokeless tobacco products have a high potential to produce nicotine dependence. Nicotine replacement therapies may therefore be useful for smokeless tobacco cessation attempts.

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