

Published in final edited form as:

Addict Behav. 2007 September ; 32(9): 1970–1975.

A Measure of Nicotine Dependence for Smokeless Tobacco Users

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Abstract

The objective of the present study was to examine the properties of a modification of the Fagerström Test of Nicotine Dependence in a large sample of smokeless tobacco (ST) users. The subjects for this study included 256 males who were recruited for a tobacco cessation intervention that involved a visit with a dentist and advice to quit smoking during the exam. At baseline, the modified dependence scale was administered to the participants and a saliva sample was collected to measure cotinine. The correlation between the total score and salivary cotinine was moderate among the ST only users ($r = 0.34$), whereas it was lower ($r = 0.19$) among the ST + cigarette users. Among ST only users, the coefficient alpha was 0.40; however it was considerably higher among the ST + cigarettes group ($\alpha = 0.61$). In both cases, the coefficient alpha was lower than the recommended value of 0.70. Future research should focus on refining questionnaires that more precisely measure nicotine dependence in smokeless tobacco users.

Keywords

Smokeless tobacco; Nicotine; Dependence measure

Introduction

Smokeless tobacco (ST) use in the United States has been decreasing steadily since 1987 and the prevalence estimate in 2000 was 2.3% overall and 4.5% among men (Nelson et al., 2006). However, use is still high in some regions of the country, including the Appalachian region in Ohio where 10% of males use ST (ODH, 2006). Clearly, tobacco cessation strategies need to continue to target this group of users. Understanding the concept of dependence is an important step in developing effective interventions (Fiore et al., 2000). Dependence in cigarette smokers can be assessed by measuring cotinine, a major metabolite of nicotine that has become the standard marker of nicotine exposure (Jarvis et al., 1987). Heatherton and colleagues examined the relation between cotinine and questions on the Fagerström Test of Nicotine Dependence (FTND) (Heatherton et al., 1991). They reported a negative relation between cotinine and time to first cigarette in the morning and a positive relation between cotinine and smoking more in the morning and smoking while severely ill.

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The objective of the present study was to examine the properties of a modification of the FTND in a large sample of ST users. The strength of this study is that some of the ST users also smoked cigarettes, which allowed us to separate the sample into two groups based on tobacco use and examine the scale properties in each group.

Methods

Subjects

The subjects for this study were recruited for a tobacco cessation intervention that involved a visit with a dentist and advice to quit smoking during the exam. Intervention group participants received nicotine replacement therapy and lay-led counseling sessions. Recruitment occurred at public locations in two counties in the Appalachian region of Ohio and only men who used smokeless tobacco daily were eligible to participate in the intervention. The Ohio State University Institutional Review Board approved all of the study procedures.

Measures

The baseline questionnaire included items to measure tobacco use, demographics, and nicotine dependence. This latter scale, designed by Severson & Gordon (1997), was based on the original FTND and modified for ST users (Table 1). Because all of the men in this study were daily users, the score on item 2 was automatically 2 (i.e. used ST 6–7 days per week); hence, the total scale score ranged from 2 to 9. Saliva samples were obtained from all men at baseline. Cotinine was extracted from saliva using a gas chromatography/mass spectrometry (GC-MS) technique (Hariharan & VanNoord, 1991).

Statistical Analysis

Descriptive statistics were calculated for the entire sample and also by groups defined by tobacco use (ST only versus ST + cigarette smoking). The total score on the dependence scale and each individual item were correlated to salivary cotinine levels using Spearman's nonparametric correlation method. Only 5 items could be included in the analysis of the scale's homogeneity because items 2 and 6 had no variability: all men were daily users (item 2) and the analysis was performed separately for ST only users and ST + cigarettes (item 6). The internal consistency reliability of the scale was assessed by estimating the Cronbach alpha coefficient (Cronbach, 1951).

Results

The descriptive statistics for the entire sample and for the ST only and ST + cigarettes groups are presented in Table 2. The cotinine distribution was highly skewed and a square-root transformation of the raw values normalized the data; therefore, all of the results are reported from analyses using the square-root cotinine. Table 3 contains the mean and standard deviation of salivary cotinine levels, as well as the Spearman rank correlation coefficient, by item on the dependence scale and the total score. The correlation between the total score and salivary cotinine was 0.34 ($p < 0.0001$) among the ST only users, whereas it was 0.19 ($p = 0.24$) among the ST + cigarette users. The coefficients for the items ranged from -0.09 to 0.38 . For three of the five items, the correlation between the response and cotinine was larger in magnitude for the ST only group compared to the ST + cigarettes group; however, no statistical tests were performed to determine if the coefficients differed between the two groups. Among ST only users, the coefficient alpha was 0.40; however, it was 0.61 among the ST + cigarettes group.

Discussion

The results of this study suggest that there is a moderate correlation between the total score on the dependence questionnaire and level of salivary cotinine among the 216 men who were ST only users. The correlation coefficient, 0.34, is similar in magnitude to the one reported by Boyle et al. ($r = 0.30$) in their examination of a 9-item variation of the FTND among 121 ST users (Boyle et al., 1995). Five of the items on their scales tapped similar behaviors as the scale in this present study (time to first use, difficulty refraining, use while ill, frequency of use, and swallowing juices). In a recent report of yet another variation of the FTND, Ebert and colleagues estimated a correlation of 0.53 between the total score and cotinine level in 42 ST users (Ebert et al., 2006). This scale was comprised of six items; four of which overlapped with the scale used in the present study (time to first use, use while ill, frequency of use, and swallowing juices).

The coefficient alpha for the scale used in the sample of ST only users was 0.40, which is low, but similar to what other authors have reported for nicotine dependence scales (range 0.3 to 0.52) (Ebert et al., 2006; Boyle et al., 1995). The coefficient alpha does increase with the number of items included on a scale (Streiner & Norman, 1995). Therefore, the observed alpha of 0.40 in this analysis of 5 items (from a scale that includes a total of 7 items) scale is comparable to the larger scales examined in other studies. It is possible that the samples of ST users in all of these studies are fairly homogeneous, which is a condition that will result in a low measure of reliability (internal consistency in this case) (Streiner & Norman, 1995).

The results were quite different when we examined the scale in the group of men who used ST and smoked cigarettes. While the correlation between the total score and salivary cotinine level was lower ($r = 0.19$), the coefficient alpha for the scale was higher ($\alpha = 0.61$). It is not entirely clear why this pattern was observed. It is possible that the correlation with cotinine was lower because the mixed users smoke cigarettes in addition to using ST, and the dependence questionnaire asks only about ST dependence behaviors.

The main limitation of this study is that the ST users were male volunteers who were interested in joining a tobacco cessation study and they were all from the Appalachian region in one state, which could limit the generalizability of the findings. A second limitation relates to the number of items used in the scale. It was designed to have a total score that ranged from 0 to 9. Because the men had to be daily users to participate, one item was scored identically for all participants. Furthermore, the cigarette smoking item had to be eliminated since exclusive ST users could not respond. Thus, only five of the questions could be examined.

In conclusion, the scale examined in this study was moderately correlated with salivary cotinine level in a sample of daily ST users. Future research should focus on refining scales to more precisely measure nicotine dependence in ST users. Additionally, the group of mixed tobacco users should be further studied, as there was a low correlation between the dependence score and level of cotinine. It is possible that cotinine is not an adequate marker of dependence in these users, or that the scale needs to be modified to include questions about cigarette use.

Acknowledgements

This study was supported by a grant from the National Institutes of Health (R01 DE13926). The contents are solely the responsibility of the authors and do not necessarily represent the official views of the National Institutes of Health.

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Table 1**Dependence Questions and Response Options**

| Question | Response |
|---|---|
| 1. How many tins/pouches of smokeless tobacco do you typically use each week? | 0 = < 1 per week 1 = 2–4 per week 2 = 5+ per week |
| 2. How often do you use smokeless tobacco? | 0 = ≤1 day/week 1 = 2–5 days/week 2 = 6–7 days/week |
| 3. Do you intentionally swallow tobacco juices? | 0 = No 1 = Yes |
| 4. Do you use smokeless tobacco when you are sick or have mouth sores? | 0 = No 1 = Yes |
| 5. How soon after awakening from your normal sleeping period do you use chewing tobacco or snuff? | 0 = After 30 min 1 = Within 30 min |
| 6. Do you smoke cigarettes? | 0 = No 1 = Yes |
| 7. Is it difficult for you not to use smokeless tobacco where its use is restricted or not allowed? | 0 = No 1 = Yes |

Table 2
Subject Characteristics* for the Entire Sample and by Tobacco Use Group

| Variable | Total Sample (n=256) | ST Only Users (n=216) | ST + Cigarettes (n=40) |
|--------------------------------------|----------------------|-----------------------|------------------------|
| Age ^{††} | 34.3 ± 11.1 | 34.8 ± 10.9 | 31.5 ± 11.9 |
| ST Use Duration [†] (years) | 15.5 ± 9.6 | 16.3 ± 9.7 | 11.7 ± 8.0 |
| Age at ST Initiation | 14.5 ± 7.1 | 14.3 ± 6.6 | 15.4 ± 9.4 |
| Salivary Cotinine (ng/mL) | 545 ± 365 | 560 ± 369 | 460 ± 332 |
| Range of Cotinine (ng/mL) | 17–2469 | 17–2469 | 33–2097 |
| Educational Attainment | | | |
| ≤HS Diploma | 52.0% | 50.5% | 60.0% |
| More than HS | 48.0% | 49.5% | 40.0% |
| Marital Status [†] | | | |
| Never Married | 19.1% | 15.7% | 37.5% |
| Married | 62.9% | 66.2% | 45.0% |
| Divorced/Widowed/Separated | 18.0% | 18.1% | 17.5% |

* Mean ± standard deviation reported for continuous variables

[†] p<0.005 for test comparing ST only users to ST + cigarettes

^{††} p<0.02 for test comparing ST only users to ST + cigarettes

Table 3
Mean and Standard Deviation of Square-Root Transformed Cotinine by Smokeless Tobacco Use Group and Dependence Question*

| Item | ST Only Users (n=216) | | | ST + Cigarettes (n=40) | | |
|------------------------------|-----------------------|------------|----------------|------------------------|------------|----------------|
| | n | Mean ± SD | r [†] | N | Mean ± SD | r [†] |
| Tins/pouches per week | | | | | | |
| Less than 1 | 26 (13%) | 20.8 ± 8.5 | 0.09 | 7 (18%) | 18.4 ± 4.4 | 0.07 |
| 2-4 | 80 (38%) | 22.3 ± 7.8 | | 16 (41%) | 21.6 ± 8.0 | |
| 5 or more | 102 (49%) | 23.0 ± 6.9 | | 16 (41%) | 20.0 ± 6.5 | |
| Intentionally swallow juices | | | | | | |
| No | 142 (66%) | 20.9 ± 7.6 | 0.28 | 26 (65%) | 19.7 ± 5.2 | 0.05 |
| Yes | 74 (34%) | 25.2 ± 7.2 | | 14 (35%) | 21.0 ± 9.0 | |
| Use of ST when sick | | | | | | |
| No | 116 (54%) | 21.4 ± 7.8 | 0.15 | 24 (60%) | 19.3 ± 8.1 | 0.20 |
| Yes | 100 (46%) | 23.5 ± 7.5 | | 16 (40%) | 22.0 ± 3.8 | |
| Time to first use in morning | | | | | | |
| After 30 minutes | 95 (44%) | 20.1 ± 8.4 | 0.29 | 26 (65%) | 21.1 ± 6.5 | -0.09 |
| Within 30 minutes | 121 (56%) | 24.2 ± 6.6 | | 14 (35%) | 19.0 ± 7.2 | |
| Difficult to refrain | | | | | | |
| No | 129 (60%) | 21.2 ± 8.4 | 0.19 | 16 (40%) | 17.8 ± 4.4 | 0.38 |
| Yes | 87 (40%) | 24.1 ± 6.4 | | 24 (60%) | 22.5 ± 7.6 | |
| Total Score | | | 0.34 | | | 0.19 |

* Question on cigarette use omitted because groups were defined by cigarette smoking and question on frequency of use was omitted because all participants were daily users

[†] Spearman's Rank correlation coefficient