The assessment of tobacco dependence in young users of smokeless tobacco

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ABSTRACT

Introduction As all published measures of dependence for users of smokeless tobacco (dippers) have poor reliability, in the present work the Hooked on Nicotine Checklist (HONC) and the Autonomy Over Smoking Scale (AUTOS) were evaluated for use with this population. Dippers and smokers were also compared in relation to dependence, the pleasure derived from using tobacco and the latency to the onset of withdrawal.

Methods In 2010, an anonymous self-completed paper survey was administered to 1541 students of mixed race and ethnicity in grades 9–12 (mean age 15.9 years) in a Florida high school where students used cigarettes and smokeless tobacco.

Results The reliability (Cronbach's α) for the HONC was 0.90 for smokers (n=139) and 0.91 for dippers (n=85), and for the AUTOS was 0.94 for smokers and dippers. Dippers and smokers did not differ significantly in relation to scores on the HONC, AUTOS, latency to withdrawal onset or pleasure derived from smoking. One or more symptoms on the HONC were reported by 56% of dippers and 57% of smokers with <100 lifetime uses of their favoured tobacco product, and by 91% of dippers and 91% of smokers with ≥100 lifetime uses (not significant). Greater lifetime use was associated with a significantly shorter latency to withdrawal for smokers and dippers.

Conclusions The HONC and AUTOS are highly reliable measures of dependence for adolescent users of cigarettes and smokeless tobacco. Using these measures and other indicators, no meaningful differences in dependence were found between dippers and smokers at comparable levels of lifetime use.

There are no validated measures of tobacco dependence that can be used in relation to more than one type of tobacco product. This prevents comparisons between users of different products, or populations where different forms of tobacco use predominate. There are also no reliable measures of dependence on smokeless tobacco in the literature. A version of the Fagerström Tolerance Questionnaire (FTQ) adapted for smokeless tobacco had poor reliability (Cronbach's α=0.52),[1 2] as did two versions of the Fagerström Test for Nicotine Dependence (α=0.40 and 0.47),[3 4] and two versions of the modified FTQ (mFTQ, α=0.30 and 0.47).[1 3]

The Hooked on Nicotine Checklist (HONC) and the Autonomy Over Smoking Scale (AUTOS) are two reliable and validated measures of nicotine dependence in smokers.[5 6] Whereas it would be useful to have instruments that could be used internationally to measure tobacco dependence in populations where different types of tobacco product are used, or in individuals who use more than one type of tobacco product, our first aim was to evaluate the psychometric properties of these measures when reworded to allow their completion by smokers as well as users of smokeless tobacco.

To the best of our knowledge, only one previous study has compared nicotine dependence in smokers and users of smokeless tobacco (hereafter termed dippers).[7] The investigators concluded that 'smokeless tobacco in adolescence has a potential to induce nicotine dependence which is at least as high as for cigarette smoking'. A limitation of that study was that it 'did not employ a complete instrument for the assessment of nicotine dependence', relying instead on selected individual items.[7] Our second aim was therefore to characterise tobacco dependence in adolescent dippers and compare dependence in dippers and smokers using validated instruments.

Youth who get pleasure from their first smoking experience are more likely to continue smoking,[8] but very little is known about the role of pleasure in nicotine dependence. Our third aim was to explore the relationship between the pleasure derived from using tobacco and measures of tobacco use and dependence.

The elapsed time between the last use of tobacco and the onset of withdrawal-induced cravings is termed the latency to withdrawal (LTW).[9–11] The LTW correlates well with multiple measures of dependence.[9] The LTW may prove to be an important clue to the pathophysiology of addiction as it affords a quantitative measure of the physiological process of nicotine withdrawal.[12] Consistent with neurophysiological properties of nicotine, smokers differ widely in their LTW, ranging from minutes to weeks.[9–12] The trajectory of escalating frequency of use after the onset of smoking[13] is attributed by smokers to the fact that the LTW shortens progressively with time, prompting them to light up at shorter intervals.[12 14] The LTW has never been studied in dippers. The fourth study aim was to investigate the LTW in dippers.

We hypothesised that (1) the HONC and AUTOS would show good psychometric properties when used with dippers; (2) dippers and smokers would show comparable levels of dependence; (3) the pleasure from using tobacco would not decrease with increasing lifetime consumption; and (4) the LTW in dippers would be shorter in subjects with higher levels of lifetime consumption as it is in smokers.

METHODS

Subjects

The study was conducted in a single Florida high school, chosen because its students use smokeless

tobacco. All students in science classes in grades 9–12 were invited to participate (science is required for 99% of students). To be eligible to participate, students had to have parental permission and be present on the survey day. There were no other inclusionary or exclusionary criteria. A letter that provided a mechanism for parents to exclude their child from the study was sent to the parents of all 2095 enrolled students. This resulted in the exclusion of eight students (0.4%). A total of 30 students (1.4% of the student body) present at the time of the survey chose not to participate; no further information on these students is available. Students who were absent or away on a field trip did not participate. Ethical approval was granted by the University of Massachusetts Medical School.

Survey content and administration

The anonymous survey was distributed in science classes by the regular teachers and took 20 min to complete. Survey items assessed use of cigarettes and smokeless tobacco.

As students at this school refer to smokeless tobacco as 'dip', this term was used throughout the survey. The use of dip and cigarettes was assessed using separate items, each of which offered 12 response options. Subjects that responded to the first three options ('I have never used dip', 'I have tried dip once or twice, but that is all', 'I have used dip several times, but I don't use it now') were considered not to be current users. The remaining options were 'I use dip, but not every month', 'I use dip, but not every week', 'I use dip about 1 day per week', 'I use dip about 2 days per week' and so on, up to 'I use dip every day if I can'. To assess smoking, the words 'I smoke' were substituted for 'I use dip' for each item. We considered subjects that endorsed any response indicating 'I use dip' or 'I smoke' to be current users. We divided current tobacco users into dippers and smokers based on the product used most frequently. Thus, the dippers included subjects that used dip exclusively and those that used dip more frequently than cigarettes. The smoking group included subjects that used cigarettes exclusively and those that used cigarettes more frequently than dip. A total of 22 subjects that used both products equally were excluded from comparisons of dippers and smokers.

Lifetime use was assessed separately for cigarettes and dip using items with response options of never, only once, 2, 3 or 4 times, 5–9 times, 10–19 times, 20–99 times and ≥100 times. Due to small cell sizes, the data for these items were collapsed into dichotomous variables of <100 and ≥100, as is customary.[15]

The HONC and the AUTOS were reworded to make items applicable to either cigarettes or dip and the same instruments were administered to all tobacco users. The conceptual framework for the HONC and AUTOS as measures of dependence has been published.[5 16] The loss of autonomy has been defined as the presence of symptoms that would make quitting smoking difficult or unpleasant, thus the presence of any of the 10 HONC symptoms indicates a loss of autonomy (table 1). The HONC has maximum sensitivity in the lower range of the dependence spectrum[17] and has demonstrated excellent predictive validity in relation to the trajectory of smoking,[6 16] and in one adolescent study predicted smoking status 6 and 12 months after the intervention.[18] Internal consistency with smokers was excellent in four adolescent studies (α=0.90–0.94), with moderate interitem correlations (mean =0.49).[6 18–20] The HONC is currently used in 20 languages to measure dependence in smokers of all ages.[21 22]

The AUTOS is a 12-item measure of tobacco dependence (table 2).[5] Like the Fagerström measures, the AUTOS provides a dependence score without a cut-off score, and the endorsement of a single item does not indicate dependence. The AUTOS is a tool intended for the assessment of the development and resolution of three aspects of dependence: nicotine withdrawal,

Table 1 Frequency of endorsement of the Hooked on Nicotine Checklist (HONC) items by lifetime use

		Dippers*			Smokers		
The Hooked on Nicotine Checklist	**Lifetime use**	**N**	**Endorsement (%)**	**p Value†**	**N**	**Endorsement (%)**	**p Value†**
Have you ever tried to quit, but couldn't?	<100	34	0	0.000	60	6.7	0.002
	≥100	43	39.5		55	29.1	
Do you smoke or use dip now because it is really hard to quit?	<100	34	0	0.000	61	8.2	0.004
	≥100	43	41.9		55	29.1	
Have you ever felt like you were addicted to tobacco?	<100	34	17.6	0.006	61	16.4	0.000
	≥100	42	47.6		55	61.8	
Have you ever had strong cravings to smoke or use dip?	<100	34	38.2	0.000	61	37.7	0.000
	≥100	42	81.0		54	74.1	
Have you ever felt like you really needed a cigarette or a dip?	<100	34	38.2	0.000	61	42.6	0.000
	≥100	43	79.1		53	79.2	
Have you ever found it hard to keep from smoking or using dip in places where you are not supposed to, like school?	<100	34	20.6	0.001	61	9.8	0.000
	≥100	43	58.1		54	48.1	
When you tried to stop smoking or using dip… (or, when you haven't used tobacco for a while…)							
Did you find it hard to concentrate because you couldn't smoke or dip?	<100	34	5.9	0.004	58	12.1	0.000
	≥100	43	32.6		52	44.2	
Did you feel more irritable because you couldn't smoke or dip?	<100	34	8.8	0.000	58	20.7	0.000
	≥100	42	54.8		52	65.4	
Did you feel a strong need or urge to smoke or dip?	<100	34	17.6	0.000	58	25.9	0.000
	≥100	42	69.0		52	61.5	
Did you feel nervous, restless or anxious because you couldn't smoke or dip?	<100	34	5.9	0.000	58	12.1	0.000
	≥100	42	45.2		52	55.8	
Loss of autonomy (any of the above)	<100	34	55.9	0.000	61	57.4	0.000
	≥100	43	90.7		55	90.9	

*None of the comparisons between dippers and smokers within each level of lifetime use were significant.
†p Value for χ^2 test for the vertical comparison of lifetime use within each population of dippers and smokers considered separately; p<0.005 is significant when corrected for multiple comparisons.

Table 2 Frequency of endorsement of the Autonomy Over Smoking Scale (AUTOS) items by lifetime use

		Dippers			Smokers		
The Autonomy Over Smoking Scale	**Lifetime use**	**N**	**Endorsement (%)**	**p Value***	**N**	**Endorsement (%)**	**p Value***
Withdrawal subscale							
When I go too long without a cigarette or a dip I feel nervous or anxious	<100	39	17.9	0.000	78	12.8	0.000
	≥100	46	58.7		58	60.3	
When I go too long without a cigarette or a dip I lose my temper more easily	<100	39	10.3	0.000	78	9.0	0.000
	≥100	46	63.0		58	63.8	
When I go too long without a cigarette or a dip I get strong urges to smoke or dip that are hard to get rid of	<100	39	25.6	0.000	78	12.8	0.000
	≥100	46	80.4		58	71.9	
When I go too long without a cigarette or a dip I get impatient	<100	39	23.1	0.000	78	19.2	0.000
	≥100	46	80.4		58	70.7	
Psychological reliance subscale							
I would go crazy if I couldn't smoke or use dip	<100	39	7.7	0.000	78	15.4	0.000
	≥100	46	58.7		58	55.2	
I rely on smoking or dipping to deal with stress	<100	39	35.9	0.000	78	46.2	0.000
	≥100	46	82.6		58	77.6	
I rely on smoking or dipping to take my mind off being bored	<100	39	46.2	0.000	78	39.7	0.006
	≥100	46	84.8		58	63.8	
I rely on smoking or dip to focus my attention	<100	39	10.3	0.000	78	10.3	0.000
	≥100	46	54.3		58	41.4	
Cue-induced desire to smoke							
After eating I want a cigarette or a dip	<100	39	10.3	0.000	78	10.3	0.000
	≥100	46	65.2		58	65.5	
When I smell cigarette smoke I want a cigarette†	<100	39	7.7	0.001	78	56.4	NS
	≥100	45	37.8		58	72.4	
When I see other people smoking or using dip I want a cigarette or a dip	<100	39	69.2	0.003	78	67.9	0.000
	≥100	46	93.5		58	93.1	
When I feel stressed I want a cigarette or a dip	<100	39	43.6	0.000	78	57.7	0.000
	≥100	46	97.8		58	89.7	

*p Value for χ^2 test for the vertical comparison of lifetime use for dippers and smokers considered separately; $p<0.007$ is significant when corrected for multiple comparisons.
†This was the only item for which dippers and smokers differed significantly from one another ($p<0.001$ for both levels of lifetime use).

cue-induced desires to use tobacco and psychological reliance on tobacco use. Response options for each AUTOS item include 'describes me not at all', 'describes me a little', 'describes me pretty well', and 'describes me very well' scored 0–3. The AUTOS provides an overall score (potential range 0–36) and scores for the three four-item subscales (range 0–12, table 2). We used the total AUTOS score and subscale scores as continuous measures. For χ^2 analyses, due to small cell sizes, responses to the 12 items were dichotomised as 'describes me not at all' versus all other responses. With smokers, the AUTOS demonstrates excellent reliability in different populations (α=0.91–0.97) and concurrent validity: symptom counts are associated with age of smoking initiation, lifetime use, smoking frequency and history of failed cessation.[5] The AUTOS is undergoing evaluation in five languages. One item from the cue-induced desire to use tobacco subscale was not felt to be relevant to dippers and was left unchanged ('When I smell cigarette smoke I want a cigarette'). This should be borne in mind when interpreting differences between dippers and smokers on this item and the 'cue-induced desire to use tobacco' subscale.

Subjects were asked 'How much pleasure do you get from smoking a cigarette or using dip?', and responses were recorded on a 10-point Likert scale, with 0 anchored at 'none' and 9 at 'a great deal'.

One item assessed the LTW by asking 'How long can you usually go without smoking or using dip before you feel such a strong desire to smoke or use dip that it is hard to ignore?'; response options ranged from minutes to more than 4 weeks. This item has excellent concurrent validity and test–retest reliability (r=0.85).[9] Through years of use and detailed interviews with smokers, we have established that our measures of the LTW are highly specific for the onset of nicotine withdrawal and do not assess craving triggered by any factor other than withdrawal.[9–11] Some beginner tobacco users do not experience a strong desire to use tobacco as a withdrawal symptom, and the survey instructed such individuals to skip this question, accounting for the smaller number of respondents for this outcome.

Statistical analysis

The internal reliability of the HONC and AUTOS was assessed using Cronbach's α. Interitem and item-total correlations were calculated. For stratified comparisons, dippers and smokers were split according to lifetime use of <100 versus ≥100 dips or cigarettes respectively. χ^2 was used for bivariate analyses of dichotomous variables. An analysis of variance (ANOVA) was used to compare dippers and smokers in relation to the HONC, AUTOS, pleasure ratings and LTW while controlling for age. A p value criteria of <0.05 was used for scale scores; and adjusting for multiple comparisons, <0.005 was used for individual HONC items, and <0.007 for individual AUTOS items. SPSS V17.0 (SPSS, Chicago, Illinois, USA)was used for all analyses.[23]

RESULTS

Participation and demographics

Completed surveys were returned by 1541 students, 70% of whom were white, 10.3% Hispanic, 10.3% of mixed race, 6.1% black, 1.8% Asian and 1.6% Native American/Pacific Islander. Excluding 8 students without parental consent, and 30 students that declined to participate, surveys were completed by all students present at the time of the survey, representing 73.6% of enrolled students, with the remainder being absent or away on

field trips. The mean age was 15.9 years (range 11–19, SD 1.2) and 49.2% were female.

Tobacco use in the population

A total of 1534 students described their smoking and dipping status. Current use of cigarettes or dip was reported by 246 subjects (73.6% male, 76.3% Caucasian, 8.6% Hispanic, 9.8% mixed race, 2.9% black, 1.6% Asian and 0.8% Native American/Pacific Islander). There were 120 subjects that used cigarettes exclusively and 19 more that used cigarettes more often than dip, resulting in 139 current tobacco users that were exclusively or predominantly smokers, hereafter referenced as smokers (mean age 16.1 years (SD 1.2), 44.6% male, 9.1% of all respondents). There were 59 subjects that used only dip and 26 that used dip more often than cigarettes, resulting in 85 subjects who were exclusively or predominantly dippers, hereafter referenced as dippers (mean age 16.3 years (SD 1.2), 100% male, 5.5% of all respondents). A total of 22 subjects that used both products with equal frequency were excluded from the subsequent analyses (1.4% of all respondents and 9% of all current tobacco users).

Psychometrics of the HONC

The HONC demonstrated a reliability of 0.90 for smokers and 0.91 for dippers. Item-total correlations ranged from 0.57 to 0.73 for smokers and 0.60 to 0.79 for dippers. Reliability was not improved by deleting any of the 10 items for either smokers or dippers. Interitem correlations ranged from 0.32 to 0.70 (mean=0.48) for smokers and 0.30 to 0.82 (mean=0.48) for dippers, indicating that the excellent reliability was not attributable to excessive interitem correlations.

Psychometrics of the AUTOS

Reliability for the AUTOS was 0.94 for smokers and 0.94 for dippers. Interitem correlations were moderate, ranging from 0.39 to 0.83 (mean=0.58) for smokers and 0.10 to 0.80 (mean=0.55) for dippers. Item-total correlations ranged from 0.58 to 0.86 for smokers and 0.69 to 0.81 for dippers with the exception of 'When I smell cigarette smoke I want a cigarette', which correlated at 0.25 for dippers. The reliability with smokers was not improved by deleting any item. For dippers, deletion of 'When I smell cigarette smoke…' increased reliability from 0.94 to 0.95. The reliability of the AUTOS with the retention of this item was excellent, so the full instrument was used for comparisons of dippers and smokers.

Concurrent validity of the HONC and AUTOS

As an indication of concurrent validity, symptom prevalence increased significantly in relation to lifetime use for all 22 HONC and AUTOS items for dippers and for 21 items for smokers (the exception being 'When I smell cigarette smoke…' tables 1 and 2). Having demonstrated that both measures are valid and reliable, we went on to compare dependence in dippers and smokers using these measures.

Comparing dependence in dippers and smokers using the HONC

The endorsement of ≥1 HONC symptoms was reported by 55.9% of dippers and 57.4% of smokers with lifetime use <100, and by 90.7% of dippers and 90.9% of smokers with lifetime use ≥100 (no significant differences). There were no significant differences between dippers and smokers on any individual HONC item when the data were analysed with stratification by lifetime use (table 1), or without stratification (data not shown). There were no differences between dippers and smokers on the mean HONC score when the data were analysed with stratification by lifetime use (table 3), or without stratification (table 4). Because the HONC was near the end of the survey, fewer subjects completed it (n=193) than the AUTOS (n=224).

Comparing dependence in dippers and smokers using the AUTOS

Dippers and smokers did not differ in relation to the total AUTOS scores when the data were analysed with (table 3) or without (table 4) stratification for lifetime use. On the AUTOS subscale scores, dippers and smokers differed only in relation to the cue-induced desire subscale, which contained the item: 'When I smell cigarette smoke…'.

When dippers and smokers were compared on the individual AUTOS items with stratification by lifetime use, they differed only on the item 'When I smell cigarette smoke I want a cigarette' (table 2). When compared without stratification by lifetime use (table 5, online), dippers were significantly less likely to endorse wanting to smoke when smelling cigarette smoke ($p<0.001$), were more likely to endorse strong urges during withdrawal ($p=0.007$) and trended towards more reliance on tobacco to cope with boredom ($p=0.008$, with $p<0.007$ indicating significance).

The latency to withdrawal

Dippers and smokers reported long LTWs, with a mean of 296 h (12.4 days) for dippers and 313 h (13.0 days) for smokers (no significant difference, table 4). Dippers and smokers with ≥100 lifetime uses had significantly shorter LTWs than those with <100 lifetime uses ($p<0.001$, table 3).

Pleasure

Dippers rated the pleasure they received from dipping at 5.9 (range 0–9, SD 2.04, n=77). Pleasure ratings correlated well with the HONC score ($r=0.55$, $p<0.001$), the AUTOS score ($r=0.55$, $p<0.001$) and the number of times dip was used in a typical week ($r=0.45$, $p<0.001$), and correlated inversely with the LTW ($r=-0.50$, $p<0.001$).

Smokers rated the pleasure they received at 5.6 (range 0–9, SD 2.39, n=114), with no significant difference from dippers either overall or when stratified by lifetime use (tables 3 and 4). Smokers' pleasure ratings correlated well with the HONC score ($r=0.59$, $p<0.001$), the AUTOS score ($r=0.58$, $p=0.001$) and with the number of cigarettes smoked in a typical week ($r=0.40$, $p<0.001$), and correlated inversely with the LTW ($r=-0.34$, $p=0.002$).

In dippers and smokers, pleasure was significantly greater in subjects that had ≥100 lifetime uses of their preferred product ($p<0.001$, table 3).

As our items were worded to apply to either cigarettes or dip, it is unclear which product dual users might have been thinking of when they answered each question. We therefore repeated all analyses while eliminating the dual users: no difference in any outcome was seen (data not shown).

DISCUSSION

To measure dependence uniformly across all forms of tobacco use, the HONC and AUTOS include no items concerning how the product is used. These measures show comparable psychometric properties for smokers and dippers and concurrent validity in relation to lifetime use. Their excellent reliability with dippers ($\alpha=0.91-0.94$) cannot be attributed to item redundancy as interitem correlations are moderate. The reliabilities of the HONC and AUTOS with dippers far exceed those of five FTQ-based measures of smokeless tobacco dependence ($\alpha=0.30-0.52$).[1 3 4]

Table 3 A comparison of dippers and smokers in relation to multiple continuous measures with stratification by lifetime use

		Dippers				Smokers			
	Lifetime use	N	Mean	SD	p Value*	N	Mean	SD	p Value*
HONC score	<100	34	1.53	2.11	0.000	61	1.89	2.38	0.000
	≥100	43	5.42	3.22		55	5.31	3.32	
AUTOS score	<100	39	3.92	4.45	0.000	78	4.96	5.01	0.000
	≥100	46	16.7	8.78		58	16.1	10.0	
Withdrawal subscale	<100	39	0.92	1.71	0.000	78	0.73	1.66	0.000
	≥100	46	5.65	3.66		58	5.29	4.20	
Psychological reliance subscale	<100	39	1.18	1.47	0.000	78	1.60	2.01	0.000
	≥100	46	5.26	3.45		58	4.33	3.27	
Cue-induced desire to use tobacco subscale†	<100	39	1.82	1.90	0.000	78	2.63	2.08	0.000
	≥100	46	5.74	2.54		58	6.48	3.34	
Pleasure from smoking/using dip	<100	36	4.83	1.98	0.000	60	4.68	2.03	0.000
	≥100	41	6.83	1.61		54	6.61	2.38	
Latency to withdrawal, h	<100	16	573	234	0.000	26	575	231	0.000
	≥100	34	166	219		41	147	202	

*p Value for the vertical contrast of lifetime use for dippers and smokers analysed separately.
†This was the only measure on which dippers and smokers differed significantly from one another in this table ($p<0.05$ for both levels of lifetime use).
AUTOS, Autonomy Over Smoking Scale; HONC, Hooked on Nicotine Checklist.

Presumably, an appropriately worded measure of tobacco dependence should be valid for users of all tobacco products, just as indicators of alcoholism are the same for all drinkers regardless of their preferred beverage. In the absence of any meaningful differences in the performance of the HONC and AUTOS with adolescent dippers and smokers, we recommend that these scales should undergo additional assessments of their concurrent and predictive validity with dippers of all ages. We would recommend changing the wording of one problematic item to 'When I smell cigarette smoke or dip I want to smoke or dip', and changing the name of the Autonomy Over Smoking Scale (AUTOS) to the Autonomy Over Tobacco Scale (AUTOS). A planned study will extend the evaluation of the HONC and AUTOS to users of waterpipes.

We believe our study is the first to report on dependence in dippers of any age group using a validated scale with good reliability. We found no clinically meaningful differences between dippers and smokers at comparable levels of lifetime use in relation to the prevalence of any symptom assessed by the HONC and AUTOS. Our data suggest that dippers and smokers experience tobacco dependence in the same way. This appears to contradict a report that some dependence symptoms were much more common in Swedish adolescent snus users than in smokers.[7] In that study, many more snus users had progressed to daily use, and the analyses did not control for lifetime use as was performed in this study.

Our data demonstrate that many different symptoms of tobacco dependence are present in smokeless tobacco users and smokers before they have used the product 100 times.[24 25] The single exception is that none of the 34 current dippers with <100 lifetime uses had made an attempt to quit (table 1). This is consistent with a report that Swedish adolescent snus users were less likely than smokers to make an attempt to quit.[7] We speculate that adolescents see less danger in using smokeless tobacco and therefore have less motivation to quit.

Beginning dippers and beginning smokers both reported very long LTWs, and dippers and smokers with ≥100 uses reported significantly shorter LTWs than those with <100 lifetime uses. These data are entirely consistent with the known properties of the LTW[9–12] and are important because this is the first study to evaluate the LTW in users of smokeless tobacco. These data suggest that the phenomenon of shortening of the LTW operates in smokers and users of smokeless tobacco.

We observed an increase in pleasure with increasing lifetime consumption of dip and cigarettes. If tolerance to pleasurable effects explained escalating tobacco use, pleasure and frequency of use should correlate inversely (a decrease in pleasure prompting a compensatory increase in frequency). We observed the opposite: a moderately strong direct correlation between pleasure and frequency of use in relation to dip ($r=0.45$, $p<0.001$) and cigarettes ($r=0.40$, $p<0.001$). Our data suggest a hypothesis that the pleasure derived from tobacco use increases over time in proportion to the growing strength of the addiction. Although this is only one of many plausible interpretations of these data, our hypothesis is supported by the moderately strong and consistent correlations between pleasure and scores on the HONC and AUTOS ($r=0.55$ to 0.59, $p<0.001$) and the inverse correlation with the LTW ($r=-0.34$ to -0.50,

Table 4 A comparison of dippers and smokers in relation to multiple continuous measures without stratification by lifetime use

	Dippers			Smokers			
	N	Mean	SD	N	Mean	SD	p Value
HONC score	77	3.70	3.38	116	3.51	3.33	NS
AUTOS score	85	10.81	9.54	139	9.50	9.34	NS
Withdrawal subscale	85	3.48	3.76	139	2.62	3.74	NS
Psychological reliance subscale	85	3.39	3.40	139	2.71	2.94	NS
Cue-induced desire to use tobacco subscale	85	3.94	2.99	139	4.18	3.32	NS
Pleasure from smoking/using dip	77	5.90	2.04	114	5.60	2.39	NS
Latency to withdrawal, h	50	296	293	67	313	298	NS

AUTOS, Autonomy Over Smoking Scale; HONC, Hooked on Nicotine Checklist; NS, not significant.

What this paper adds

- It is not known whether cigarettes or smokeless tobacco are more addictive. Direct comparisons have not been possible because tobacco dependence scales developed for smokers cannot be used for other types of tobacco products.
- This study demonstrates that two valid and reliable measures of dependence developed with smokers have identical psychometric properties when used with users of smokeless tobacco. When adolescent smokers and users of smokeless tobacco were compared with these measures, there were no meaningful differences in their levels of dependence.
- This study has important implications for the measurement of dependence in countries where cigarette smoking is not the only form of tobacco used.

$p<0.002$). Although pleasure may be multifaceted, our single-item measure of pleasure shows excellent retest stability and substantial concurrent validity.[26]

This study is important because it is the first to report highly reliable measures of dependence in smokeless tobacco users; the first to compare smokers and dippers using a validated measure of dependence; the first to assess the LTW in dippers; and the first to systematically examine pleasure in relation to dependence, frequency of use and lifetime use. Additional study strengths include the use of an unselected community sample of adolescent dippers and smokers with different levels of experience.

Study limitations include the use of a convenience sample from one geographical location. Our sample did not include adults; additional studies will be needed to evaluate the reliability and validity of the HONC and AUTOS for use in adult dippers. The sample size for dippers was modest and did not include a large number of heavy users. A much larger sample size might have produced statistically significant differences between dippers and smokers on some measures, but it would be debatable whether small differences would have any clinical importance. A larger sample would have also allowed the population that had used tobacco <100 times to be broken into finer subcategories to examine dependence and scale performance for those at the lowest levels of lifetime tobacco use. More research is needed to evaluate the concurrent and predictive validity of the HONC and AUTOS for use with dippers in longitudinal and smoking cessation studies. The dual use of cigarettes and oral tobacco is not uncommon.[27] Individuals that used both tobacco products would have had a greater number of lifetime exposures to tobacco than would be indicated by their lifetime exposure to their preferred product. The retention of dual users did not affect the outcome of any analyses, and their elimination would have left a sample that was not representative of the population of dippers.

Our data suggest that the HONC and AUTOS are valid and reliable measures of tobacco dependence for use with adolescent smokers and dippers. Using these measures, we found no meaningful differences in dependence between dippers and smokers. Our intent is to extend the evaluation of the HONC and AUTOS as scales that could potentially be used with users of any type of tobacco product. The ideal would be to have a selection of instruments that could each be administered to cigarette smokers, waterpipe smokers and users of any type of oral tobacco. This would facilitate international comparisons in the burden of tobacco addiction.

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