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### Smokeless Tobacco Use and Knowledge among University Students

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#### ABSTRACT

**Objectives:** The authors explored the use, demographics, knowledge, and the impact of a statewide smoking ban on smokeless tobacco use among college students. **Participants and Methods:** During spring of 2008, 417 students enrolled at a Midwestern state university completed a 12-item survey. **Results:** Twenty-two percent of males in this sample have recently used smokeless tobacco. Participants had a mean knowledge score of 7.8, constructed from nine items on the survey. Non-users scored higher ( $p < .001$ ) than users and females scored higher ( $p < .001$ ) than males. Users ( $N=34$ ) did not demonstrate a significant difference ( $p = .71$ ) in use after the implementation of a statewide smoking ban. **Conclusions:** Knowledge does not appear to be the only factor influencing the use of smokeless tobacco. Additional research is needed to investigate other factors including the impact of a statewide smoking ban on smokeless tobacco use.

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#### INTRODUCTION

This study surveyed postsecondary students at a Midwestern university to explore demographics of student smokeless tobacco users, including gender, age, major, and geographic origin. In addition, this study investigated student knowledge of smokeless tobacco and the relationship between tobacco knowledge and smokeless tobacco use. Last, the impact of a statewide smoking ban on smokeless tobacco use was explored. Researchers speculated that there may be an increase in use of smokeless tobacco resulting from the smoking ban.

Many people are unaware of the dangers of smokeless tobacco use and are under the impression that if there is no smoke, there is no danger. However, the Surgeon General stated in 1986 that smokeless tobacco use is not a safe substitute for smoking cigarettes. It can cause cancer and a number of noncancerous conditions while leading to nicotine addiction and dependence.<sup>1</sup>

#### LITERATURE REVIEW

Literature regarding smokeless tobacco is far less prevalent than for smoked tobacco such as cigarettes. In North America, smokeless tobacco products are most commonly classified as snuff or chewing tobacco.<sup>2</sup> Moist snuff is finely ground and sold in loose form or packaged like tea-bags, while chewing tobacco is relatively coarse. Both types are placed in the oral cavity either between the lip and gum or on the inside of the cheek. Adverse effects associated with smokeless tobacco, users of smokeless tobacco, and knowledge about smokeless tobacco are examined in this review.

#### Smokeless Tobacco Dependence

Determining the dependence potential of smokeless tobacco is difficult because there is no accepted standard of measurement in human subjects. Studies have modified the Fagerstrom Tolerance Questionnaire in an effort to gauge dependence on smokeless tobacco, but these have not been validated.<sup>3</sup> However, previous studies have demonstrated that similar quantities of

nicotine are absorbed, and elevated serum nicotine levels last longer when using smokeless tobacco as compared to cigarettes.<sup>4-6</sup>

A recent study in Sweden compared the nicotine dependence between 819 youth smokers, smokeless tobacco users, and dual tobacco users.<sup>7</sup> Researchers used a modified version of the Fagerstrom Tolerance Questionnaire along with the Hooked on Nicotine Checklist to investigate perceived dependence. Smokeless tobacco user and dual tobacco users were found to have an odds ratio two-to-five times greater for feeling of addiction as compared to cigarette smokers.<sup>7</sup>

### **Cancer of the Mouth/Mouth Sores**

There are more than 28 carcinogens in smokeless tobacco, including volatile and tobacco-specific nitrosamines, nitrosamino acids, polycyclic aromatic hydrocarbons, aldehydes, and metals.<sup>8</sup> While conflicting studies exist, it is generally accepted in the United States that smokeless tobacco is associated with an increased risk for oral cancer.<sup>9</sup> In 1993, a study of 128 patients with oral cancer stated that 93% of those patients reported using snuff, and 6% reported using chewing tobacco, with no other carcinogen exposure.<sup>10</sup> The five-year survival rates of oral cancers induced by smokeless tobacco are less than 50%.<sup>10</sup> Cross-sectional studies from multiple countries have found a higher incidence of oral soft tissue lesions in smokeless tobacco users, as compared to non-users.<sup>10</sup> Lesions associated with smokeless tobacco include leukoplakias, erythroplakias, snuff dipper's lesions, tobacco and lime user's lesions, verrucous hyperplasias, and submucosal deposits.<sup>9</sup> These lesions are regarded as precursors to cancer.<sup>9</sup>

### **Dental Caries (Decay)**

Smokeless tobacco users appear to have an increased risk for dental caries, particularly root caries. A study of 14,807 adults revealed that the number of decayed or filled root surfaces was significantly higher for men who currently used only chewing tobacco than for men in any of the other tobacco-use groups.<sup>2</sup> Multiple logistic regression modeling revealed that men who currently used chewing tobacco were more than four times as likely to have one or more decayed or filled root surfaces as men who never used tobacco. The relationship between the number of decayed or filled root surfaces was found to be dependent on the number of packages of chew used per week.<sup>2</sup>

### **Periodontal Disease**

While smoking tobacco has been associated with periodontal disease, smokeless tobacco appears to have a lesser effect. A study of 84 adult men including 25 current Swedish moist snuff users, 21 former users, and 38 non-users revealed no significant difference in periodontal bone levels when controlling for age.<sup>11</sup> However, gingival recession has been associated with smokeless tobacco in previous research. A study of 103 nineteen-year-old males, 33 users and 70 non-users, found 42% of users had recession, while only 17% of non-user had recession ( $p = .006$ ).<sup>12</sup> The gingival margin can migrate from 1 to 8 mm down the root of the tooth in smokeless tobacco users, generally in the area where the tobacco is placed.<sup>13</sup>

### **Cardiovascular Disease**

While research has found a clear association between cardiovascular disease and smoking tobacco, conflicting research has been published regarding the potential link between cardiovascular disease and smokeless tobacco.<sup>14</sup> A large study in 2006 with 27,089 participants in 52 countries found a higher risk of myocardial infarction associated with chewing tobacco alone (not snuff or pan) with an odds ratio of 2:23.<sup>15</sup> This effect of chewing tobacco remained after adjusting for diabetes, obesity, hypertension, exercise, and diet.<sup>15</sup> Since this study did not sample sufficient users of pan and snuff, conclusions about those specific types of tobacco could not be drawn. In 2007, a comprehensive literature review with meta-analyses was published, finding a well documented acute effect of smokeless tobacco on blood pressure and heart rate, but a chronic effect was not well demonstrated.<sup>14</sup> Studies from the United States have demonstrated an increased risk of ischemic heart disease and stroke; however, studies from Sweden have not demonstrated an increased risk.<sup>14</sup>

### **Lung Disease**

Inconclusive data exists regarding the association between lung cancer and smokeless tobacco. A comprehensive review in 2007 found three United States studies indicating an increased risk for lung cancer, while two studies from Norway and Sweden demonstrated a decreased risk.<sup>14</sup>

### **Users of Smokeless Tobacco**

Different studies conducted in the U. S. have shown that smokeless tobacco use is higher in certain demographic groups such as in men, young adults, Whites, American Indians/Alaska Natives, residents of rural areas, people who live in southern, western, and north central states (Midwest), persons with lower levels of education, and people who have blue collar, service/laborer occupations or are unemployed.<sup>16</sup> It is estimated that 3% of adults currently use smokeless tobacco nationally.<sup>17</sup>

In 2005, 5.1% of young adults between the ages of 18 and 25 reported currently using chewing tobacco or snuff.<sup>18</sup> Of all adult age groups, male users aged 25 to 44 years have reported the highest prevalence of smokeless tobacco use,<sup>16</sup> and the average time for initiation of snuff or chew use is seventh grade.<sup>16,19</sup>

Smokeless tobacco and baseball have long been associated with each other. A 10-yr study of smokeless tobacco use in a professional baseball organization reported out of 282 major league baseball players surveyed in 1988, 34% were current users while subsequent work has shown rates from 24.8 to 46%.<sup>20</sup> This was compared to a general population use rate of 3.4% according to the 2000 National Household Survey on Drug Abuse.<sup>20</sup>

Few studies have examined the use of smokeless tobacco in college students. A web survey of 21,410 college students from 13 Texas universities found that about 17.1% were current users of smokeless tobacco.<sup>21</sup> As expected, use was higher among male students, with 31.8% reporting they had tried smokeless tobacco at least once, and 22.4% reporting current use. In women, 8.5% reported using smokeless tobacco at least once, and 3.2% were current users.<sup>21</sup> These findings were consistent with a previous survey of 5,894 students from 72 colleges and universities across the US in which 22% of males reported smokeless tobacco use, and 2% of females reported use.<sup>22</sup> According to Glover et al, college students typically switch from using smokeless tobacco to cigarettes.<sup>22</sup>

### **Knowledge about Smokeless Tobacco**

Knowledge about smokeless tobacco has been investigated in children and high school populations. Fifth, eighth, and eleventh grade students were surveyed in West Virginia resulting in a sample of 808 male students, 19.8% of whom reported current smokeless tobacco use.<sup>19</sup> The researchers designed a knowledge score using 10 variables, and found a significant difference between users and non-users ( $p = .01$ ). Non-users were found to associate smokeless tobacco with all diseases listed, and 91% believed smokeless tobacco was harmful to their health. Only 74% of users believed smokeless tobacco was harmful to their health, and they were four times more likely to agree that smokeless tobacco is a safe alternative to cigarettes. Users were more than twice as likely to agree that it is okay to use it safely for a few years.<sup>19</sup>

Tomar et al. examined the knowledge regarding smokeless tobacco of 11,093 high school seniors who represented the US for the Monitoring the Future Project for 1999 through 2003.<sup>2</sup> Researchers found 52.7% of high school seniors perceived an equal risk of harm from using cigarettes or smokeless tobacco, 41.3% believed cigarettes were more harmful, and 6.1% believed smokeless tobacco was more harmful.<sup>2</sup> Limited studies have explored knowledge about smokeless tobacco among college students. One study was found that compared tobacco use knowledge among college students in China and the United States, but the study combined smoking and smokeless tobacco information, and individual assessment items were not available.<sup>23</sup>

### **Recent Reviews of Smokeless Tobacco Health Effects**

Smokeless tobacco use has been proposed by some public health parties as an alternative to cigarette smoking as part of a harm reduction strategy. Unfortunately, published studies regarding the health effects of smokeless tobacco are highly controversial, leading both the public and health care providers to varied conclusions. In 2010, a systematic epidemiologic review of 11 case-control studies and 11 cohort studies were examined to determine to disease risk from smokeless tobacco use.<sup>3</sup> This review reported finding a small increased risk for all-cause mortality in smokeless tobacco users as compared to non-tobacco users; however, this risk was considerably lower than the mortality risk of cigarette smokers. Inconsistent studies were found linking smokeless tobacco use to oral cancer, pancreatic cancer, lung cancer, cardiovascular disease, myocardial infarctions and strokes. The authors suggest that study design issues and small samples, combined with the type of smokeless tobacco product used complicate analysis of these studies. The authors suggest that insufficient research has been completed to suggest that smokeless tobacco use should be suggested as part of a harm reduction strategy.<sup>3</sup> In 2009, a systematic review of 62 studies completed in the United States found smokeless tobacco users have a significant increased risk of oropharyngeal and prostate cancer, with a possible increased risk for oesophagus, pancreas, larynx, and kidney cancer.<sup>24</sup> With the publication of so many conflicting studies, it is easy to understand why both the both the public and health providers may have inadequate knowledge regarding smokeless tobacco.

### **METHOD**

A survey was used to collect information about university students' smokeless tobacco use, the impact of a statewide smoking ban, and students' current knowledge about smokeless tobacco. Human subject approval was obtained from the Institutional Review Board at the university the study was conducted. Prior to completing the survey, instructions along with information about the study and consent were distributed to all participants. Participants signed and turned in the informed consent independent of the survey to ensure confidentiality.

A 12-item survey was developed and patterned after the instrument used by Goebel.<sup>14</sup> The survey was piloted with 24 dental hygiene students prior to distribution to the sample. A convenience sample of students enrolled in multiple sections of an introductory health course (N=471) was used. Surveys were distributed and collected during the same class session. A total of 417 (88.5%) completed the survey. The time required to complete the survey was approximately five minutes. Oral instructions were provided in addition to the written instructions. To assess current use, participants were asked to indicate how many days they used smokeless tobacco in the past 30 days. To assess previous use, participants were asked how many days they used smokeless tobacco in the 30 days before the smoking ban was effective. The third question assessed the influence of six factors (enjoy it, calming, social, can't stop, unable to smoke in public, influence of use in athletic activities) in the use of smokeless tobacco.

- Questions four through six were used to develop a smokeless tobacco knowledge score for participants, and are listed in Table 1. The smokeless tobacco knowledge score had a range of 0 to 9, with 9 indicating accurate knowledge of smokeless tobacco risks. The internal consistency of the items used to identify the knowledge score had a Cronbach's alpha of 0.657. The final questions of the survey were related to demographics such as age, race, and geographic origin.

Data were collected and analyzed with SPSS Version 10.0. Given the nature of the data, both parametric and nonparametric tests were run. Surveys were analyzed using independent *t* tests and Wilcoxon signed rank tests. Statistical significance for all tests was set at  $p < .05$ .

**Table 1. Smokeless Tobacco Knowledge Items**

Item	Score
<b>Do you think chewing tobacco, snuff or dip causes any of the following illnesses?</b>	
Cancer of the mouth	Yes (1) or No (0)
Mouth sores	Yes (1) or No (0)
Heart disease	Yes (1) or No (0)
Tooth decay	Yes (1) or No (0)
Gum disease	Yes (1) or No (0)
<b>Indicate the level you agree with each statement</b>	
Smokeless tobacco is harmful to your health.	Strongly Agree or Agree (1) I don't know, Disagree, Strongly Disagree (0)
Smokeless tobacco is safer to use than cigarettes.	Strongly Agree, Agree, I don't know (0) Disagree, Strongly Disagree (1)
Smokeless tobacco is safe to use for a few years.	Strongly Agree, Agree, I don't know (0) Disagree, Strongly Disagree (1)
<b>In regards to addiction levels, which statement do you believe to be true?</b>	
Smokeless tobacco is much less addictive than cigarettes.	0
Smokeless tobacco is somewhat less addictive than cigarettes.	0
Smokeless tobacco is equally addictive to cigarettes.	1
Smokeless tobacco is somewhat more addictive than cigarettes.	1
Smokeless tobacco is much more addictive than cigarettes.	1

## Results

The typical participant was female, Caucasian, from a small town, and 20 years old. Further descriptive items are listed in Table 2. Participants in the study represented over 41 declared majors and males represented 31% of this sample.

**Table 2. Demographics of Participants**

<b>Item</b>	<b>Valid Percent</b>
<b>Gender</b>	
Male	30.9
Female	69.1
<b>Age</b>	
18	26.4
19	37.3
20	15.9
21	6.3
22-23	8.1
24-64	6.0
<b>Race</b>	
White	91.5
Black	2.7
Asian	3.9
Hispanic	0.7
Other	1.2
<b>Permanent Address</b>	
Rural (Country or Lake)	12.0
Small town	26.0
Moderate town	14.2
Moderate city	19.3
Large city, not suburb	3.9
Suburb	20.0
Metropolis	4.6
<b>Attendance in Bars</b>	
Not 21	76.5
21, but do not go to bars	3.6
1-2 times/month	6.7
3-4 times/month	6.0
5-8 times/month	4.8
9 or more times/month	2.4

## Use of Smokeless Tobacco

The majority (91.8%) of college students in this study did not report use of smokeless tobacco, as seen in Figure 1. Of the 34 users identified, 82.4% were males, and 55.9% were under the age of 21. The permanent address for users was varied, with 41.2% from a rural area, lake or a small town, 29.4% from a moderate town or city, and 29.3% from a large city, suburb or metropolis. According to gender, 21.9% of male students were users of smokeless tobacco, while only 2.1% of female students were users.

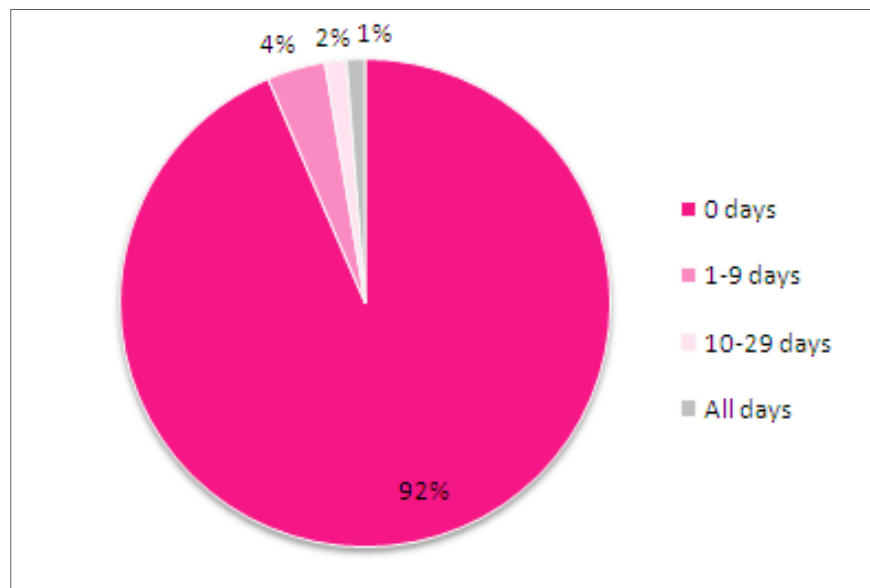


Figure 1. Use of smokeless tobacco within past 30 days

Smokeless tobacco users cited liking the product and relieving stress as their top two reasons for use (see figure 2). Relatively few users indicated they used smokeless tobacco because they were unable to smoke in public places. A Wilcoxon Signed Rank test revealed no significant differences in the use of smokeless tobacco before and after the smoking ban in public places ( $p = .71$ ).

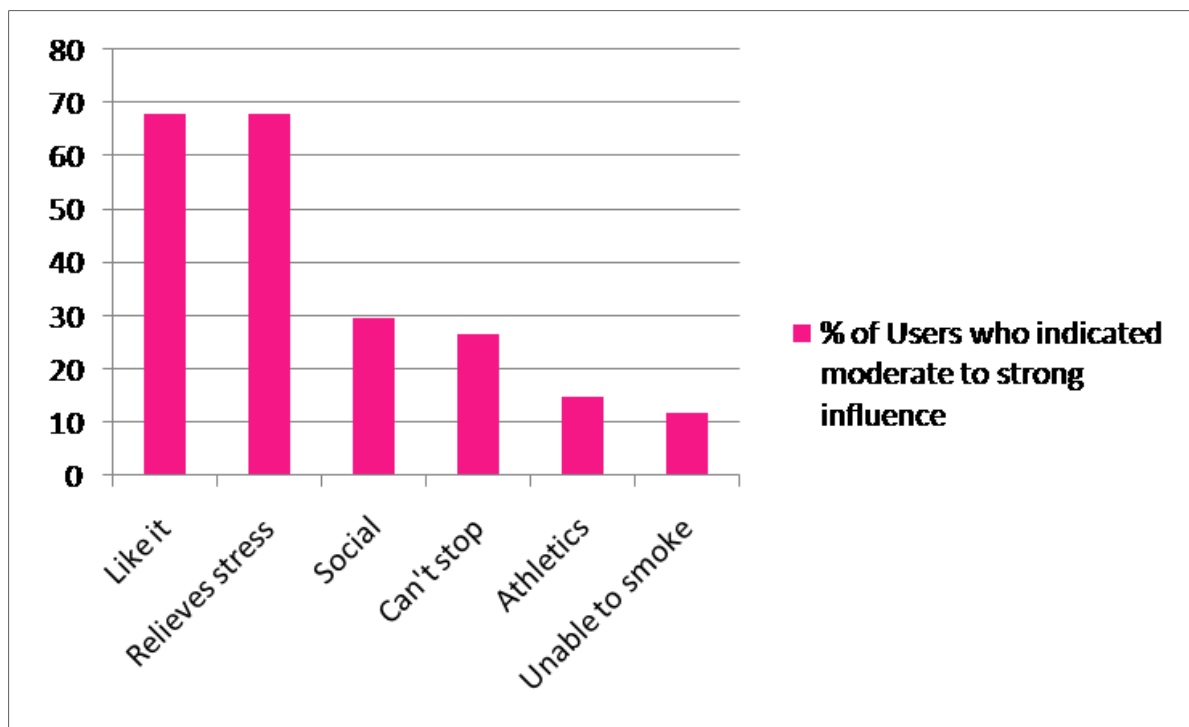


Figure 2. Reasons for use of smokeless tobacco

### Knowledge about Smokeless Tobacco

Based on previous research, a nine-item knowledge test for smokeless tobacco was developed. The mean knowledge score for this sample of college students was 7.8. Less than 1% of students were unaware that smokeless tobacco is associated with cancer of the mouth; however, 25.6% of college students were unaware of the association between smokeless tobacco and heart disease. Nine percent did not agree that smokeless tobacco was harmful to health, and 18.7% of students were unsure or agreed that smokeless tobacco was safe to use for a few years. When examining alternatives, 16.2% of college students believed smokeless tobacco is safer to use than cigarettes, and another 30.4% were unsure. Regarding addiction, 14.5% of college students believed smokeless tobacco was less addictive than cigarettes.

Independent t-tests were performed to examine differences in knowledge according to groups, as described in Table 3. Non-users were found to have significantly higher knowledge scores than users ( $p < .001$ ). Females were found to have significantly higher knowledge scores than males ( $p < .001$ ). Knowledge scores were not significantly different when health-related majors such as nursing and dental hygiene were compared. However, nursing majors did have significantly higher knowledge scores when compared to business, marketing and accounting majors ( $p = .02$ ). When examining the specific questions within the knowledge score, users were significantly more likely to perceive smokeless tobacco as safer or equal in harm to cigarettes when compared to non-users ( $p = .02$ ). Additionally, users were more likely to believe smokeless tobacco was safe to use for a few years ( $p < .001$ ). Non-users were significantly more likely to perceive smokeless tobacco as equal as or more addictive than cigarettes, as compared to users ( $p = .02$ ).

**Table 3. Differences in Smokeless Tobacco (ST) Knowledge Scores**

	Pair	N	Mean	SD	t
Knowledge score	Non-user	374	7.9	1.1	***4.5
	User	33	7.0	1.5	
ST safer than cigarettes	Non-user	381	3.8	0.9	*2.3
	User	33	3.4	1.0	
ST safe to use for a few years	Non-user	383	4.3	0.8	**3.7
	User	33	3.7	0.9	
ST's addictiveness compared to cigarettes	Non-user	378	3.0	0.6	*2.4
	User	34	2.7	0.9	
Knowledge score	Female	279	8.0	1.1	***5.2
	Male	125	7.4	1.2	
Knowledge score	Dental Hygiene	21	8.2	1.0	-0.41
	Nursing	61	8.1	0.8	
Knowledge score	Nursing	61	8.1	0.8	*2.5
	Business/Marketing/Accounting	57	7.6	1.4	

Note \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

### DISCUSSION

Consistent with previous research, this study found 21.9% of males were using smokeless tobacco, as compared to 22.4% and 22% in previous studies.<sup>16,17</sup> The number of female users was also similar with 2.1% in this study compared to 3.2% and 2% previously.<sup>16,17</sup> The percentage of male users from these studies was substantially higher than found in 2000, when 5.5% of males between the ages of 18 and 24 reported currently using chewing tobacco or snuff.<sup>13</sup> A convenience sample was used in this study, which limits generalizability. In addition females were oversampled; however, using the liberal education course did sample students from over 41 majors, across broad disciplines.

Reasons for smokeless tobacco use were asked to explore influence of factors, such as the smoking ban, on use. The top two reasons users reported for use of smokeless tobacco were because they liked it and because it relieved stress. Relatively few users indicated they used smokeless tobacco because they were unable to smoke in public places, and no significant difference in use patterns was found before and after the smoking ban. However, 79.6% of students in this sample were age 20 years or



younger, and unable to go to bars. Further studies are needed to determine if the statewide smoking ban has impacted use of smokeless tobacco in other demographics.

When examining illnesses associated with smokeless tobacco use, 25.6% of college students were unaware of the association between smokeless tobacco and heart disease. Since the literature about the relationship between cardiovascular disease and smokeless tobacco is both recent and contradictory, this lack of awareness is not surprising. Ninety-one percent of non-user college students perceived smokeless tobacco as harmful to health, identical to the 91% of non-users in fifth, eighth, and eleventh grades in previous research.<sup>14</sup> Fewer users (12.1%) in college perceived smokeless tobacco as safe, as compared to grade school users (26%).<sup>14</sup> This finding suggests that college students are more aware that smokeless tobacco is harmful; however this did not decrease the percentage of users.

Users were more likely to perceive smokeless tobacco safer than cigarettes ( $p = .02$ ), similar to the findings that users were four times more likely to consider smokeless tobacco a safe alternative.<sup>14</sup> We find it interesting that 30.4% of college students were unsure if smokeless tobacco was a safe alternative to cigarettes, suggesting further education may be warranted. Additionally, users were more likely to perceive smokeless tobacco as safe to use for a few years ( $p < .001$ ), similar to previous research in which users were more than twice as likely to agree that it is okay to use smokeless tobacco safely for a few years.<sup>14</sup> The perception of safety may be tied to perception of addictiveness, since 14.5% of college students believed smokeless tobacco to be less addictive than cigarettes, and users were significantly more likely to have this perception ( $p = .02$ ).

Regarding overall knowledge about smokeless tobacco, this research was consistent with prior research in that non-users demonstrated significantly higher knowledge scores than users ( $p < .001$ ).<sup>14</sup> Females were much less likely to be users of smokeless tobacco and had significantly higher knowledge scores than males ( $p < .001$ ). The researchers were interested in examining if declared major was related to smokeless tobacco knowledge, speculating majors related to health disciplines might score higher. Students with a business/marketing/accounting major had a significantly lower mean knowledge score when compared to nursing majors. Students from two different health disciplines, nursing and dental hygiene, did not have significantly different knowledge scores.

One of the major limitations of this research was the design of the knowledge score. While patterned after previous research, the original survey score was not examined for reliability.<sup>14</sup> Cronbach's alpha reliability tests revealed a score of 0.657, which is marginally acceptable in exploratory research. When used in previous research, heart disease was not considered to be related to smokeless tobacco. Despite some conflicting research, the authors decided enough evidence existed to score one point on the knowledge score for the "yes" answers in response to chewing tobacco, snuff, or dip causing heart disease. Controversy exists on the safety of chewing tobacco, and research has shown cigarettes are associated with more types of cancer and diseases leading some to believe smokeless tobacco is a safe alternative to cigarettes. However, smokeless tobacco has been linked with several conditions including oral cancer and contains over 28 carcinogens.<sup>3</sup> Clearly, health educators should not advocate smokeless tobacco as a "safe" alternative to smoking.

## CONCLUSION

Previous research has determined that smokeless tobacco is associated with oral cancer, mouth sores, dental caries, and gum recession. Recent research also suggests smokeless tobacco is associated with cardiovascular disease. However, conflicting results from original research and meta-analyses complicate education regarding smokeless tobacco. This study suggests education needs to include the latest research findings on diseases and conditions associated with smokeless tobacco, preferably before the seventh grade when studies have shown the average smokeless tobacco user initiates use. Smokeless tobacco should not be promoted as a safe alternative to cigarettes, and this education should continue into postsecondary education.

Knowledge does not appear to be the only factor influencing the use of smokeless tobacco, as college students in this sample appear to be more knowledgeable about smokeless tobacco, but the percentage of users remains stable. Since this study used a convenience sample, results cannot be generalized to other college students. Further research is needed to determine other factors that influence use of smokeless tobacco among college students. Additionally, this study hypothesized that a statewide smoking ban might impact the percentage of students using smokeless tobacco. While the results of this study showed that students below drinking age did not appear to increase smokeless tobacco use in response to the ban, more research is needed to assess use in individuals age 21 and older, who may be more greatly impacted by the ban's enforcement in drinking establishments.



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