Vulnerability to Smokeless Tobacco Use Among Those Dependent on Alcohol or Illicit Drugs

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Received May 13, 2013; accepted August 14, 2013

ABSTRACT

Introduction: Individuals dependent on alcohol or illicit drugs are vulnerable to cigarette smoking and related adverse health outcomes. Less research has been conducted regarding whether these same groups are vulnerable to smokeless tobacco (ST) use. The goal of this study is to examine vulnerability to ST use among individuals with other drug dependence.

Methods: Utilizing the most recent (2011) National Survey on Drug Use and Health (NDSUH), we determined odds ratios (*OR*s) for current cigarette smoking and ST use among those with current alcohol, cocaine, heroin, and marijuana dependence, adjusting for relevant sociodemographic characteristics. Vulnerability to cigarette smoking was assessed to confirm that alcohol and illicit drug dependence were associated with increased smoking in these data sets, as shown in prior studies. Identical analyses were completed in the 2009 and 2010 NSDUH to assess generality.

Results: Odds for current cigarette smoking were increased for each category of dependence ($p < .0005$): alcohol (*OR* with 99% CI = 3.30 [2.58, 4.21]), cocaine (*OR* = 4.50 [1.53, 13.20]), heroin (*OR* = 7.84 [1.92, 32.03]), and marijuana (*OR* = 3.55 [2.59, 4.88]). Odds for current ST use were also increased among those with alcohol dependence (*OR* = 1.56 [1.06, 2.30], $p = .003$) but not illicit drug dependence. Generality of the findings was confirmed in the 2009 and 2010 NSDUH.

Conclusions: Consistent with earlier reports, alcohol and illicit drug dependence are associated with robust increases in risk for cigarette smoking. In the case of alcohol dependence, but not illicit drug dependence, this vulnerability also extends to ST use.

INTRODUCTION

Smoking is among the leading preventable causes of morbidity and premature death in the United States and other industrialized countries (Danaei et al., 2009). The adverse health consequences of smoking include coronary heart disease, stroke, numerous site-specific cancers, and other chronic disease (USDHHS, 2004). Smoking prevalence is unevenly distributed in the U.S. population, as well as in other industrialized countries, with those with psychiatric disorders being especially at high risk for cigarette smoking (Lasser et al., 2000; Lawrence, Mitrou, & Zubrick, 2009). Increased vulnerability to cigarette smoking among individuals with other drug use disorders, the group of interest in this study, is well documented (Harrell, Trenz, Scherer, Pacek, & Latimer, 2012; Kalman, 1998; Richter, Ahluwalia, Mosier, Nazir, & Ahluwalia, 2002; Roll, Higgins, & Tidey, 1997). In a recent study by Harrell et al. (2012) on this topic, for example, 91% of participants who reported cocaine or heroin use in the past 6 months also reported daily cigarette smoking. A question that has not been well examined and is the purpose of this study is whether those with alcohol or illicit drug use disorders are also at increased risk for use of other tobacco products, especially smokeless tobacco (ST).

Vulnerability to ST use among those with other drug use disorders has received relatively little attention in the literature. We know of only a single report on the topic examining ST use among military enlistees (Kao, Schneider, & Hoffman, 2000). Understanding the use of ST products has become more important recently because cigarette manufacturers have released new types of ST products and are promoting dual use (Delnevo et al., 2012; Tomar, Alpert, & Connolly, 2010). ST products recently introduced in the United States, for example, include snus (Mejia & Ling, 2010), dissolvable tobacco products (Zid, 2011), and electronic nicotine delivery systems (Regan, Promoff, Dube, & Arrazola, 2013). More longstanding ST products include snuff and chewing tobacco. Snuff is made from pulverized tobacco leaves, can be dry or moist, and is generally placed between the gum and cheek rather than chewed (McKim & Hancock, 2013). Chewing tobacco can be in loose leaf, pellet, or plug forms and is placed between the gum and cheek and chewed (Boffetta,

Hecht, Gray, Gupta, & Straif, 2008). Along with increases in the availability of different types of ST products, the prevalence of ST use in the United States is increasing as well (FTC, 2011; Tomar et al., 2010). This increase in prevalence is concerning in that ST use is directly linked to numerous adverse health outcomes, including cardiovascular disease, immune system dysfunction, and reproductive complications (Willis, Popovech, Gany, & Zelikoff, 2012). Also disconcerting is the potential that dual use of tobacco products may lead to additional adverse health effects because health outcomes differ across products and may be additive (Wetter et al., 2002).

The prior study on this topic that was mentioned above examined cooccurring use of alcohol, tobacco products, and illicit drugs among low-ranking military personal aged 18–25 (Kao et al., 2000). Males and females who reported use of illicit drugs (i.e., cocaine, heroin, marijuana, or methamphetamine) were significantly more likely to also report ST use. This study examined ST use and cigarette smoking among individuals with alcohol or illicit drug dependence in civilian U.S. nationally representative samples.

METHOD

Data Source

Data were obtained from the most recent (2011) National Survey of Drug Use and Health (NSDUH) that was available for public use at the time that this study was conducted (N = 58,397; SAMSHA, 2012), a nationally representative survey of the U.S. noninstitutionalized population that includes people aged 12 and older. To examine the generality of the final model of risk factors for cigarette and ST use based on the 2011 survey to other samples, the same analyses were repeated using the 2010 and 2009 NSDUH. The NSDUH is conducted annually to assess the prevalence and correlates of drug use in the United States. The survey provides information on the use of alcohol, tobacco, illicit drugs, and other mental health problems. NSDUH recruitment is completed based on a multistage area probability sample design. Respondents were administered computer- and audio-assisted structured interviews. Respondents were selected from the civilian noninstitutionalized population, including group homes, shelters, and college dormitories. Individuals on active military duty, in drug treatment programs, jail, or homeless without residence were excluded. Respondents were compensated $30 for completing the interview. The weighted interview response rate was 74.4%, 74.7%, and 67.2% in 2011, 2010, and 2009, respectively. A detailed description of survey procedures has been provided by SAMHSA (2012). The current analyses were restricted to individuals aged 18 and older (Ns = 39,133, 39,259, and 38,067 in 2011, 2010, and 2009, respectively) as those below that age are legally prohibited from purchasing tobacco products. Restricting the study to those legally able to purchase tobacco products was done to keep opportunity to use comparable across groups of interest in this study. The sample size in cigarette use analyses was reduced by 23, 15, and 16 due to missing information on current employment in the 2011, 2010, and 2009 NSDUH, respectively. No corrections were conducted for these small amounts of missing data.

Drug Dependence Criteria

Alcohol, cocaine, heroin, and marijuana dependence were selected as the drug use categories of interest based on their association with increased risk for cigarette smoking (Lasser et al., 2000; Lawrence et al., 2009). Drug dependence criteria used in the NSDUH across each of the years examined were defined based upon the criteria listed in the Diagnostic and Statistical Manual for Mental Disorders, Fourth Edition (DSM-IV; American Psychiatric Association, 1994). Participants had to endorse at least three of seven diagnostic criteria as occurring within the past year to meet criteria for dependence (e.g., spending a great deal of time with the drug, using more than intended, and needing more of the drug to get the same effect). Only six criteria were used for marijuana dependence as the criterion related to withdrawal was not administered.

Dependent Variables

The two dependent variables in this study were self-reported: (a) smoking at least one cigarette in the past 30 days (i.e., current cigarette use) and (b) use of snuff or chewing tobacco in the past 30 days (i.e., current ST use).

Statistical Methods

Descriptive statistics and simple and multiple logistic regression analyses were conducted. Simple logistic regression analyses were used to estimate the odds of past 30-day cigarette smoking status and ST use for each dependence category (alcohol, cocaine, heroin, and marijuana) separately and each sociodemographic variable separately. Age was coded into 11 categories (i.e., 18, 19, 20, 21, 22–23, 24–25, 26–29, 30–34, 35–49, 50–64, 65+), as defined in the public release codebook (SAMHSA, 2012). Educational attainment was coded into four categories (less than high school, high school, some college, and college graduate) with "less than high school" as the reference category. Race was coded into a binary variable with non-Hispanic White versus other. Marital status was coded as married or unmarried, which included never married, divorced, and widowed. Employment status was coded as "'unemployed" if the participant was not employed and was actively looking for work or "other" if the participant was working, volunteering, disabled, keeping a house, retired, in school, or didn't have a job for another reason. Finally, associations between current cigarette smoking status and ST use were also examined using simple logistic regression. Reported odds ratios (OR) were associated with a one-unit change in the aforementioned predictor variables.

Multiple logistic regression analyses were conducted to estimate ORs for cigarette smoking and then to estimate ORs for ST use among participants reporting drug dependence for each of the four categories compared with participants not reporting that same type of drug dependence (e.g., those with alcohol dependence were compared with all those without alcohol dependence including individuals with other types of current drug dependence), after adjusting for confounding variables. The relative odds of cigarette smoking was examined to confirm that the four categories of drug dependence were associated with increased risk for cigarette smoking, as has been shown in prior studies. Multiple logistic regression analyses were conducted in three steps. First, for cigarette use and ST use outcomes, each of the four drug dependence categories of interest were entered into separate models adjusting for the influence of significant

sociodemographic variables identified in simple regressions. Second, in the ST outcome models, current cigarette smoking was added to the model to adjust for its potential confounding effects on the association between the drug dependence category and ST use. The final stage of modeling for both cigarette smoking and ST use outcomes was only conducted with those other drug dependence categories that remained significant through the earlier analyses. These final models allow us to assess whether the significant drug dependence categories were independently associated with increased odds for tobacco use.

Statistical software STATA version 12.1 was used for all analyses. The complex sampling design was taken into account by using the survey commands in STATA. The NSDUH provided weighting, stratum, and probability sampling unit variables for each survey year, and standard errors were computed using the Jackknife repeated replication method. *OR*s and 99% confidence intervals were reported. Statistical significance was defined as $p < .01$.

RESULTS

Prevalence of Cigarette Smoking and ST Use

The 2011 prevalence of current cigarette smoking and current ST use in the general population was estimated at 23.6% and 3.2%, respectively (Table 1). Among current cigarette smokers, 5.4% reported current smokeless use. Among current ST users, 39.1% reported current cigarette smoking. See Table 1 for a description of the respondent characteristics in the 2011 NSDUH.

Associations With Cigarette Smoking

Being male, younger, less educated, unmarried, unemployed, non-Hispanic Caucasian, and each of the drug dependence categories of interest increased the odds of being a current cigarette smoker in simple logistic regressions (Table 2). In separate models examining associations between each of the significant drug dependence categories, after adjusting for significant sociodemographic characteristics associated with cigarette smoking, each continued to be associated with increased odds of current smoking (Table 3, upper panel). Finally, each of the drug dependence categories remained associated with increased odds of current smoking in the separate models that simultaneously examined their independent associations with current smoking while adjusting for the influence of other types of drug dependence (Table 4).

Associations With Smokeless Tobacco Use

Being male, younger, less educated, non-Hispanic Caucasian, or alcohol, heroin, or marijuana dependent increased the odds of ST use in the simple logistic regressions (Table 2). Cocaine dependence was not significantly associated with ST use. In separate models examining associations between each of the significant drug dependence categories, after adjusting for the influence of significant sociodemographic characteristics associated with ST use, current alcohol and heroin dependence continued to be associated with increased odds of current ST use, whereas marijuana dependence did not (Table 3, upper panel). Current alcohol and heroin dependence also remained

Table 1. Demographic Characteristics and Prevalence Estimates for Current Cigarette Smoking, Smokeless Tobacco (ST) Use, and Other Drug Dependence in the 2011 National Survey of Drug Use and Health (NSDUH) 18+ Years Weighted sample (Unweighted *N* = 39,133)

Variable	% (WSE)	Unweighted *N*
Sociodemographics		
Married	52.9 (.51)	13,751
Male	48.1 (.42)	18,473
Unemployed	5.1 (.16)	3,253
Non-Hispanic White	66.7 (.44)	24,621
Education		
<High school	14.1 (.34)	6,199
High school	30.1 (.39)	12,693
Some college	26.1 (.43)	11,673
College graduate or higher	29.8 (.40)	8,568
Age		
18–21	7.6 (.19)	9,857
22–25	7.1 (.15)	9,326
26–34	15.7 (.30)	5,626
35–49	26.4 (.37)	7,619
50–64	25.9 (.47)	4,219
65+	17.3 (.42)	2,486
Tobacco use		
Cigarettes	23.6 (.40)	11,955
ST	3.2 (.12)	1,900
Dependence		
Alcohol	3.2 (.13)	1,869
Cocaine	0.2 (.03)	133
Heroin	0.2 (.03)	95
Marijuana	0.9 (.06)	799

Note. WSE = weighted standard error.

significant and increased the odds of current ST use, after adjusting for the influence of cigarette smoking, demonstrating that their association with ST use was not mediated by smoking status (Table 3, lower panel). Finally, only alcohol dependence was associated with increased odds of ST use when considered in models that adjusted for the influence of other types of drug dependence (Table 4).

Generality of the Model

There was excellent generality of the final model of risk factors for cigarette and ST use across the 3 years examined (Table 4). Across all 3 years, being younger, male, and less educated was associated with increased odds for cigarette smoking and ST use, whereas being unmarried or unemployed was associated with increased odds for cigarette smoking but not ST use. Current cigarette use was associated with increased odds for ST use across all years.

Of greatest relevance to the purpose of this report, alcohol, cocaine, heroin, and marijuana dependence were associated with increased odds for cigarette smoking after adjusting for sociodemographic characteristics and the influence of each of the other drug dependence categories across all years. The only variance across years was that the significance level associated with heroin dependence increasing the odds for cigarette smoking in the 2010 survey fell slightly above the preselected

Table 2. Simple Logistic Regressions With Associations Between Sociodemographic and Drug Dependence Characteristics and Current Cigarette Smoking and Smokeless Tobacco (ST) Use

| | 2011 NSDUH | | | | |
| | Cigarette use | | | ST use | |
	OR	99% CI		*OR*	99% CI
Sociodemographics					
Age	0.87**	0.86, 0.89		0.88**	0.85, 0.90
Male gender	1.33**	1.19, 1.50		17.96**	10.46, 30.82
Education					
High school	0.81**	0.71, 0.93		0.88	0.65, 1.20
Some college	0.67**	0.58, 0.79		0.68*	0.50, 0.91
College graduate	0.28**	0.23, 0.33		0.39**	0.26, 0.58
Married	0.45**	0.40, 0.50		0.88	0.72, 1.09
Unemployed	2.40**	2.00, 2.88		1.02	0.72, 1.45
Non-Hispanic White	1.24**	1.09, 1.41		3.05**	2.27, 4.09
Drug dependence					
Alcohol	4.42**	3.49, 5.60		2.46**	1.71, 3.53
Cocaine	13.20**	5.71, 30.52		1.61	0.53, 4.89
Heroin	24.33**	6.95, 85.13		7.98**	3.07, 20.72
Marijuana	7.71**	5.50, 10.80		2.33**	1.45, 3.76

Notes. The reference category for education is less than high school. *OR* = odds ratio; CI = confidence interval; NSDUH = National Survey of Drug Use and Health.
*p < .01,**p < .0005.

Table 3. Single Drug Dependence, Multiple Logistic Regressions, and Associations With Current Cigarette and Smokeless Tobacco (ST) Use as the Dependent Variables, After Adjusting for Significant Sociodemographic Variables in the 2011 NSDUH

| | 2011 NSDUH | | | | |
| | Cigarette use | | | ST use | |
	AOR	99% CI		*AOR*	99% CI
Single drug dependence models					
Drug dependence					
Alcohol	3.65**	2.86, 4.66		1.78**	1.21, 2.62
Cocaine	9.05**	3.47, 23.56			
Heroin	13.29**	3.71, 47.57		3.82*	1.23, 11.90
Marijuana	4.62**	3.30, 6.47		1.13	0.68, 1.87
Single drug dependence models adjusting for current cigarette smoking					
Drug dependence					
Alcohol				1.60*	1.10, 2.33
Heroin				3.20*	1.03, 9.89

Notes. AOR = adjusted odds ratio; CI = confidence interval; NSDUH = National Survey of Drug Use and Health.
*p < .01, **p < .0005.

p value of .01 (*p* = .013) where it was below that level in the other years.

Results were consistent across all years regarding the relationship between drug dependence and ST use, with only alcohol dependence being significantly associated with increased odds in the final model after adjusting for the influence of sociodemographic characteristics, cigarette smoking status, and other drug dependence categories (Table 4). Note that heroin dependence was associated with increased odds for ST use until the final step in modeling the 2011 survey results but not the 2010 or 2009 survey results. Similarly, cocaine dependence was associated with increased odds for ST use up to the final

step in modeling results from the 2010 survey but not 2011 or 2009 survey results. Marijuana dependence did not reach statistical significance in any ST models beyond simple logistic regressions in 2011 or either of the other years examined.

DISCUSSION

Researchers have reported an increased vulnerability to cigarette smoking among those with alcohol (Battjes, 1988; Monti, Rohsenow, Colby, & Abrams, 2000) and illicit drug dependence

Table 4. Final Model Multiple Logistic Regressions Adjusting for Significant Sociodemographic, Each Drug Dependence Characteristics, and Their Associations With Current Cigarette Smoking and Smokeless Tobacco (ST) Use

| | 2011 NSDUH | | | | 2010 NSDUH | | | | 2009 NSDUH | | | |
| | Cigarette use | | ST use | | Cigarette use | | ST use | | Cigarette use | | ST use | |
	AOR	99% CI	AOR	99% CI	AOR	99% CI	AOR	99% CI	AOR	99% CI	AOR	99% CI
Sociodemographics												
Age	0.94**	0.92, 0.95	0.89**	0.86, 0.91	0.94**	0.92, 0.95	0.86**	0.83, 0.89	0.93**	0.92, 0.95	0.86**	0.84, 0.89
Male gender	1.31**	1.16, 1.48	17.43**	10.14, 29.97	1.31**	1.18, 1.46	19.05**	10.86, 33.40	1.22**	1.11, 1.34	23.54**	14.71, 37.65
Education												
High school	0.78**	0.66, 0.91	0.81	0.59, 1.10	0.78**	0.67, 0.91	1.14	0.85, 1.54	0.82*	0.70, 0.96	1.51*	1.10, 2.07
Some college	0.63**	0.53, 0.74	0.64**	0.47, 0.88	0.60**	0.51, 0.71	1.01	0.74, 1.37	0.62**	0.51, 0.74	1.24	0.83, 1.85
College graduate	0.29**	0.23, 0.35	0.37**	0.23, 0.59	0.30**	0.25, 0.35	0.55**	0.37, 0.83	0.31**	0.25, 0.38	0.88	0.58, 1.34
Married	0.56**	0.50, 0.63			0.57**	0.50, 0.65			0.54**	0.47, 0.62		
Unemployed	1.70**	1.41, 2.04			1.52**	1.32, 1.75			1.60**	1.34, 1.90		
Non-Hispanic White	1.72**	1.50, 1.99	3.88**	2.88, 5.23	1.60**	1.36, 1.88	4.65**	3.17, 6.82	1.60**	1.42, 1.81	3.98**	2.71, 5.84
Cigarette use			1.39**	1.10, 1.75			1.37**	1.09, 1.72			1.48**	1.18, 1.87
Drug dependence												
Alcohol	3.30**	2.58, 4.21	1.56*	1.06, 2.30	3.04**	2.27, 4.06	1.62*	1.12, 2.33	3.45**	2.76, 4.32	1.84**	1.38, 2.47
Cocaine	4.50**	1.53, 13.20			2.67*	1.03, 6.92	3.11	0.96, 10.06	7.09**	2.74, 18.32		
Heroin	7.84**	1.92, 32.03	2.88	0.88, 9.42	9.75	0.93, 102.51			6.79*	1.49, 30.92		
Marijuana	3.55**	2.59, 4.88			3.86**	2.53, 5.91			2.92**	2.09, 4.07		

Notes. The reference category for education is less than high school. *AOR* = adjusted odds ratio; CI = confidence interval; NSDUH = National Survey of Drug Use and Health.
*p < .01, **p < .0005.

(Harrell et al., 2012; Lasser et al., 2000; Lawrence et al., 2009). This relationship is not unimportant as cigarette smoking is associated with increased mortality among alcohol- and illicit drug–dependent individuals (Hser, McCarthy, & Anglin, 1994; Hurt et al., 1996). Moreover, at least among alcohol-dependent patients, the risk of dying from tobacco-related causes exceeds alcohol-related causes (Hurt et al., 1996). The current report provides still further confirmation that current alcohol and illicit drug dependence are associated with a robust increase in vulnerability to cigarette smoking, even after adjusting for the potential confounding influences of sociodemographic characteristics associated with a greater likelihood of cigarette smoking. Moreover, the present results demonstrate that this vulnerability extends to current ST use among those with alcohol dependence but not cocaine, heroin, or marijuana dependence. Considering the relatively large number of alcohol- and marijuana-dependent individuals sampled and excellent concordance of results involving those two forms of drug dependence across survey years, we are confident in the generality of the results observed regarding their relations to risk of ST use in the U.S. noninstitutionalized adult population. The numbers of cocaine- and heroin-dependent individuals sampled in these surveys, by contrast, are sufficiently small to allow for a few individuals to exert considerable influence on the patterns observed in any one year, which likely accounts for the greater variability across years observed with those two types of drug dependence compared with alcohol and marijuana dependence in this study. With the broader view afforded by examining associations across three consecutive survey years, however, we deem it unlikely that cocaine or heroin dependence are independently increasing risk for ST use in the U.S. noninstitutionalized adult population although it would certainly be prudent to continue monitoring those relationships in other national data sets and future years of the NSDUH.

To our knowledge, this study represents the first examination of associations between alcohol and drug dependence and risk for ST use. The one prior study that we are aware of on this topic (Kao et al., 2000) examined associations between use (not dependence) in the past 12 months of alcohol, illicit drugs, and ST use. That study did not examine potential differences across type of illicit drug used, that is, those reporting any use of illicit drugs were treated as a group. The results of this study suggest that at least at the level of those meeting dependence criteria, there may be meaningful differences in risk for ST use across the different types of dependence. Unfortunately, this study does not contribute information helpful in understanding why such differences may occur, a topic that warrants further study. The current results diverged from those of Kao et al. in that we did not observe increased ST use among illicit drug users that could be attributed to dependence on the drugs per se.

This study also extends the results of the earlier study by Kao et al. conducted in military enlistees to the civilian U.S. population. This study demonstrates that this elevation in risk is not mediated by current cigarette smoking status, a question that was not addressed in the Kao et al. report. We did not examine whether lifetime smoking status might be a mediator. This is a possibility that merits examination in future studies. Understanding the mediators of these independent relationships between alcohol dependence and ST use could be helpful in trying to elucidate the mechanisms underpinning them. The fact that each of the different types of drug dependence was independently associated with cigarette smoking, but only

alcohol dependence was associated with increased ST use, is another piece of evidence against cigarette smoking as a mediator. Understanding the factors that impact ST use is important considering that ST consumption has increased in the United States as cigarette smoking has declined (Delnevo et al., 2012) and that tobacco companies aggressively market ST products, including dual use (Mejia & Ling, 2010).

Possible mechanisms that may lead to increased vulnerability to tobacco use among those who use or are dependent on other drugs merit mention. Among cigarette smokers, alcohol (Hughes, Rose, & Callas, 2000; Lajtha & Sershen, 2010) and drug use (Tidey, O'Neill, & Higgins, 2000) can transiently increase the reinforcing value or effectiveness of cigarette smoking. For example, in a two-choice comparison of opportunities to smoke or earn money, acute administration of d-amphetamine increases preference for the smoking option among recreational drug users, a measure of the relative reinforcing effects of the two options (Tidey et al., 2000). Acute administration of d-amphetamine also increases break point in progressive ratio schedule performance maintained by opportunities to smoke, a quantitative measure of the reinforcing effect of the programmed consequence maintaining responding (Sigmon, Tidey, Badger, & Higgins, 2003). Cocaine use increases smoking rates in controlled laboratory and naturalistic settings (Roll et al., 1997). Administration of methadone results in a dose-related increase in number of cigarettes smoked, CO levels, and increases in subjective ratings of smoking satisfaction (Chait & Griffiths, 1984), and acute alcohol administration increases smoking rates among alcoholics (Griffiths, Bigelow, & Liebson, 1976). Interestingly, marijuana use does not appear to exert proximal effects on cigarette use in controlled laboratory studies, like these other drugs of interest (Mello & Mendelson, 1986). We know of no controlled studies examining whether alcohol or illicit drug administration increases ST use, but that seems likely, especially for alcohol, considering the effects described above with cigarette smokers and below with laboratory animals. In preclinical studies with rats, for example, acute administration of nicotine enhances brain-stimulation reward, and treatment with amphetamine or morphine shifts the dose-effect curve for nicotine to the left, suggesting an enhancement of nicotine's potency in producing this effect (Huston-Lyons, Sarkar, & Kornetsky, 1993). Nicotine and cocaine combinations augment dopamine overflow in the nucleus accumbens in rats suggestive of potential enhancement of reinforcing effects (Zernig, O'Laughlin, & Fibiger, 1997), and combining nicotine with cocaine shifts the cocaine dose-effect curve for maintaining cocaine self-administration in monkeys to the left, also suggestive of an enhancement of drug-produced reinforcement with the drug combination (Freeman & Woolverton, 2009).

An important question, central to the goal of this study, is whether variables that increase vulnerability to cigarette smoking also do so for ST use. In answer to this question, we observed that risk factors of cigarette smoking are similar to those of ST use, with some notable differences. For example, the odds of cigarette smoking decreased compared with those with a less than high school education as education increased. Even though the relation between ST use and education was more complex, in the two most recent surveys, being a college graduate was protective against ST use compared with those with a less than high school education. Specific to the purpose of this study, illicit drug dependence was associated

with increased odds of cigarette smoking but not ST use. One other sociodemographic characteristic is worth mentioning is sex: Being male was associated with increased odds for both cigarette and ST use compared with females, but the risk was much higher for ST use.

There are at least three noteworthy limitations to this study. First, as discussed above, heroin and cocaine dependence are relatively rare compared with alcohol and marijuana dependence and as such a few individuals can exert considerable influence on the models in any given year, so continued vigilance in monitoring their influence on ST use is warranted. Second, the data come from an observational cross-sectional study and as such it is important to acknowledge the possibility that unmeasured other variables are responsible for increased vulnerability to both alcohol/illicit drug dependence and tobacco use. We adjusted for potential observed confounders where possible, but other possible influences cannot be ruled out. Finally, the data collected in the NSDUH are based on self-report and thus may be biased in the direction of underreporting of substance use.

FUNDING

DECLARATION OF INTERESTS

None declared.

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