

ORIGINAL INVESTIGATION

Dual Tobacco User Subtypes in the U.S. Air Force: Dependence, Attitudes, and Other Correlates of Use

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Received December 31, 2013; accepted March 10, 2014

ABSTRACT

Introduction: To describe the characteristics associated with patterns of daily and dual tobacco use among U.S. Air Force (USAF) personnel transitioning from basic military training to technical training.

Methods: Cross-sectional survey of USAF personnel in Technical Training School at Lackland Air Force Base ($N = 8,956$, response rate: 73%). Logistic regression analyzed the association of predictor variables between daily smokers, daily smokeless tobacco (ST) users, daily smokers who used ST nondaily, daily ST users who smoked cigarettes nondaily, and daily users of both cigarettes and ST.

Results: Compared to daily smokers, participants who were daily smokers/nondaily ST users were more likely to be male, would use ST and multiple forms of tobacco in the future, reported more friends using ST and cigarettes, and were more susceptible to tobacco advertising. Compared to daily ST users, daily ST users/nondaily cigarette users were more likely to live in the Midwest, would use multiple forms of tobacco in the future, reported more friends smoked cigarettes and used ST, and were more likely to try a product that claimed to be safer than cigarettes. Daily users of both cigarettes and ST were significantly more likely to be nicotine dependent than daily smokers/nondaily ST users and daily ST users/nondaily smokers.

Conclusions: Dual users are heterogeneous groups of tobacco users who are at high risk for continued tobacco use. Daily users of both cigarettes and ST have higher levels of nicotine dependence, even when compared to other dual users. Specific interventions targeted at dual users are needed in this increasingly prevalent and high-risk population.

INTRODUCTION

Concomitant use of cigarettes and smokeless tobacco (ST; “dual use” of tobacco products) is of increasing concern, particularly among youth (Agaku, Ayo-Yusuf, Vardavas, Alpert, & Connolly, 2013). Long-term ST use is associated with periodontal disease (Ernster et al., 1990); oral, esophageal, pancreatic, and lung cancer (Boffetta, Hecht, Gray, Gupta, & Straif, 2008; Stockwell & Lyman, 1986); and death from coronary heart disease and stroke (Haddock, Klesges, Talcott, Lando, & Stein, 1998; Henley, Thun, Connell, & Calle, 2005).

The Department of Defense (DoD) spends over \$1.6 billion a year on tobacco-related medical care, increased hospitalization, and lost work days (Bondurant & Wedge, 2009; Bray et al., 2009). To reduce tobacco-related illnesses, the DoD has banned both cigarette smoking and ST in all government buildings (Clinton, 1997). The U.S. Air Force (USAF) recently

extended this ban to new and emerging tobacco products, including electronic cigarettes (e-cigarettes; Bhattacharyya, 2012; Harris, 2010). The DoD made “Goal A.1” of their *Tobacco Use Prevention Strategic Plan* to reduce the smoking rate by 5% per year and ST use by 15% from the 1998 baseline rates (Bondurant & Wedge, 2009).

Dual use is also very common among military personnel. A study of over 36,000 USAF recruits reported that the prevalence of dual use of both ST and cigarettes was higher than that of exclusive ST use (3.3% vs. 1.8%) (Klesges et al., 2011). In this study, predictors of dual use included younger age, White race, male gender, and lower education level. Dual users also had heavier alcohol consumption, more risk-taking behaviors, and reported more tobacco use among peers.

Previous investigations of dual use in the military have not differentiated between different patterns of dual tobacco use (Bombard, Rock, Pederson, & Asman, 2008; Klesges et al.,

doi:10.1093/ntr/ntu056

Advance Access publication April 9, 2014

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2011). Dual users who use both ST and cigarettes on a daily basis may have different risk factors than dual users who use one tobacco product intermittently. Air Force Technical Training students might use ST in environments where smoking is prohibited and smoke cigarettes on the weekends in places where they can smoke freely.

The current study will address the issue of differing definitions of dual use by examining the demographic, behavioral, and lifestyle characteristics associated with three different types of dual users: (a) daily cigarette smokers who also use ST nondaily, (b) daily ST users who also smoke cigarettes nondaily, and (c) daily users of both cigarettes and ST. We first compared dual users to daily smokers and daily ST users who did not use more than one tobacco product, and then compared dual users to each other.

METHODS

Study Overview

This study was a collaborative effort among the University of Tennessee Health Science Center; University of California, San Francisco; Mayo Clinic; and the USAF. The data presented here were part of a large prospective cohort study baseline data collection. The study protocol was approved by the National Institutes of Health and the Institutional Review Boards of the University of Tennessee Health Science Center and the USAF at Wilford Hall Ambulatory Surgical Center in San Antonio, TX. This analysis of the de-identified data set was given exempt status by the University of California, San Francisco Committee on Human Research.

Sample Selection, Consenting, and Data Collection

Cross-sectional survey data were collected from 8,956 USAF personnel during their transition week between Basic Military Training (BMT) and Technical Training School at Lackland Air Force Base (AFB) in San Antonio, TX. All recruits first complete BMT at Lackland AFB and about one-third of Airmen stay at Lackland for Technical (advanced) Training. Airmen are completely alcohol and tobacco free during BMT and the first 2 weeks of Technical Training. Study participants were assessed during their first week of Technical Training. As such, many questions were phrased with their current nontobacco using status in mind (e.g., “Prior to Basic Military Training, did you use ST [or other tobacco product]...”).

Airmen were first consented and then presented with the study questionnaire. Since the Wilford Hall Institutional Review Board was concerned that the Airmen had just completed BMT where no training or activities were voluntary, extra steps were taken to ensure that the Airmen were reassured that participation was voluntary. The consent was read to them, no military training leaders could be present during the recruitment process, and research staff indicated verbally that participation was voluntary. All participants completed written informed consent. To minimize discomfort, participants were advised that all information would be confidential and that there would be no questions that would in any way jeopardize their Air Force careers (e.g., illicit drug use, underage drinking). Between 2011 and 2012, we recruited 8,956 participants to complete the written surveys (response rate: 73%). The research dataset was de-identified prior to analysis.

Patterns of Daily Tobacco Use

Many possible categorizations of dual and mono-tobacco use exist, varying by type and frequency of tobacco use. This analysis was restricted to daily tobacco users, and we included those who used either cigarettes, ST, or both products daily. Specifically, we were interested in five groups of tobacco users:

1. Daily smokers who did not use ST (exclusive daily smokers);
2. Daily ST users who did not smoke cigarettes (exclusive daily ST users);
3. Daily smokers who used ST nondaily (at least weekly or monthly) (daily smokers/nondaily ST users);
4. Daily ST users who smoked cigarettes nondaily (at least weekly or monthly) (daily ST/nondaily smokers); and
5. Daily users of both cigarettes and ST.

Figure 1 illustrates the breakdown of participants to achieve the categories of interest for this study.

We hypothesized that risk factors for continued tobacco use would be a function of both the increasing presence of using two tobacco products (vs. just one) and the frequency with which the products were used by dual users. We also hypothesized that the highest risk group was participants who used both cigarettes and ST on a daily basis.

Explanatory Variables

Demographics

To ensure sufficient group sizes for logistic regression models, we dichotomized different variables into meaningful binary groups. We calculated each respondent's age based on their self-reported date of birth and dichotomized the variable into <21 years of age or ≥ 21 years of age. We dichotomized highest education level into high school diploma or general educational development or any education beyond high school (vocational or some training, some college or associate degree, 4-year college degree, some postgraduate school, postgraduate degree). Race/ethnicity was coded as four categories: non-Hispanic White, non-Hispanic African American, Hispanic, and Other (including Asian, Pacific Islander, American Indian, Alaska Native, more than one race, or other). Marital status was dichotomized as married or living together, or those who were single, separated, divorced, or widowed. We dichotomized body mass index (BMI) into normal weight (BMI < 25) or overweight or obese (BMI ≥ 25), and we used the four primary regions of the United States (Northeast, South, West, and Midwest) based on standard definitions from the Centers for Disease Control and Prevention (CDC) and the U.S. Census (CDC, 2011; U.S. Census Bureau, 2014).

Nicotine Dependence

Participants were asked to report their patterns of tobacco use in the 12 months prior to BMT. To measure nicotine dependence, we used questions from the Fagerström Test of Nicotine Dependence (FTND). However, this test is difficult to use with dual users as there is one FTND for ST use (Ebbert, Patten, & Schroeder, 2008) and a different FTND for cigarette smoking (Heatherton, Kozlowski, Frecker, & Fagerström, 1991). As such, we substituted the words “tobacco product” for each of the six questions that form the FTND (see [Supplementary Appendix A](#) for instrument and scoring decisions). For example, the question “How soon after you woke up did you smoke

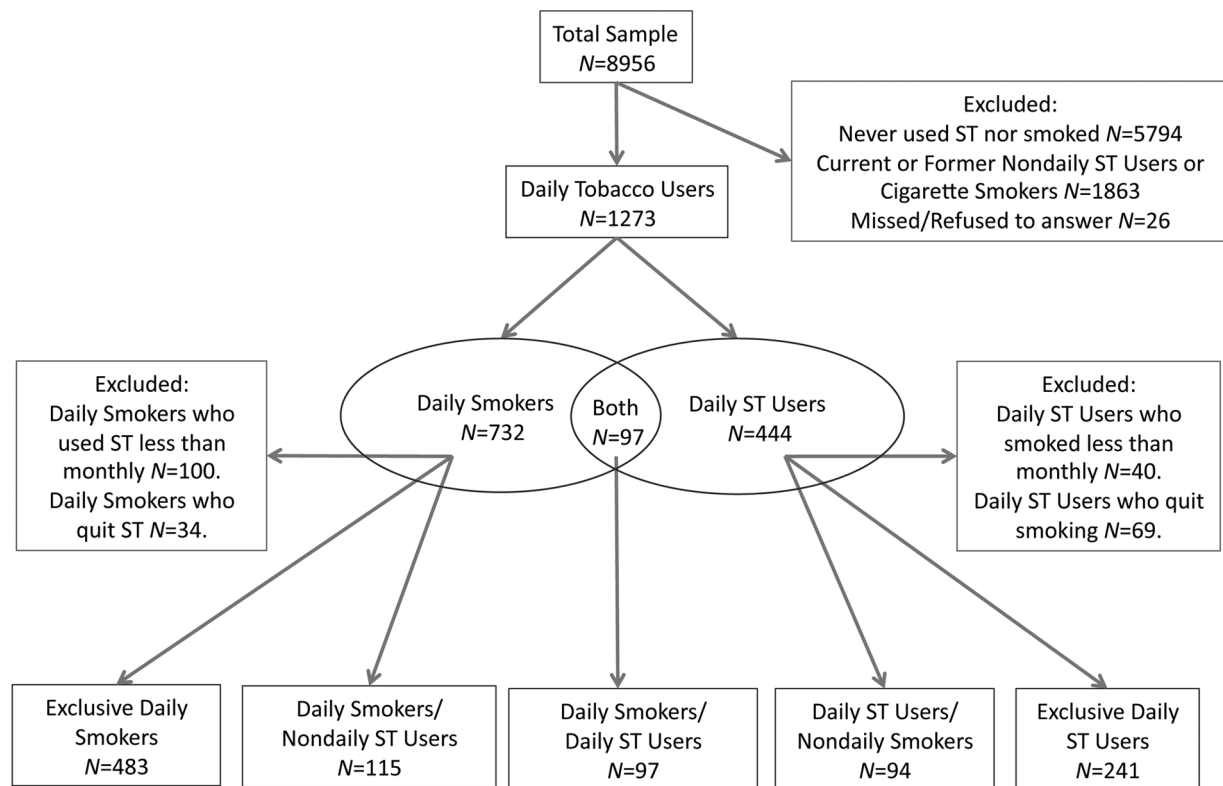


Figure 1. Tobacco use categories and inclusion/exclusion criteria. The five patterns of tobacco use (bottom boxes) are based on cigarette smoking and smokeless tobacco (ST) use only. All participants included in the study used tobacco daily. Dual users used one product (either cigarettes or ST) daily, and the other product nondaily (but at least monthly).

your first cigarette?” was modified to: “How soon after you woke up did you use your first tobacco product?”

The score also took into account the number of cigarettes smoked per day and/or the number of cans of ST used per week among daily tobacco users. Following the convention of prior studies, we classified scores into three categories: highly dependent (7–10 points), moderate dependence (4–6 points), and minimal dependence (<4 points) (Fagerström & Eissenberg, 2012; Ferketich, Wee, Shultz, & Wewers, 2007).

History of Tobacco Use

We assessed whether dual users had tried their first cigarettes and ST before 18 years of age. The first type of tobacco used was divided into three categories: cigarettes, ST, or some other form of tobacco (e.g., cigars, hookah, or other). We asked if participants had ever switched from cigarettes to ST to reduce health risks. In addition, participants reported if they had ever used nicotine replacement therapy when they couldn’t use tobacco. We also asked whether participants had made a tobacco quit attempt in the previous 12 months.

Future Tobacco Use Intentions

We compared those reporting that they would definitely use tobacco to those thinking about using tobacco or planning to remain tobacco free. We also examined whether dual users intended to use only cigarettes, only ST, or use both ST and cigarettes or multiple forms of tobacco in the future. Participants also reported whether or not they intended to use tobacco in the future to help maintain USAF weight standards.

Friends and Household Tobacco Use

We assessed if participants had a majority of friends who used ST, cigarettes, or both ST and cigarettes. A majority was defined as more than 50%. We asked if participants had lived with someone who used ST, cigarettes, or both ST and cigarettes.

Attitudes Toward Tobacco Use and Advertising Susceptibility

The survey measured attitudes about tobacco use primarily through agreement with statements rated on 5-point Likert or binary scales. We dichotomized all 5-point scales in analysis, comparing strongly agree/agree (agree) with reporting neutral, disagree or strongly disagree (do not agree). We also asked participants if they owned at least one cigarette or ST advertising item.

Athletic Participation

Participants reported whether or not they had played a varsity sport in high school or college and which sports they played. Participation in each of the six most commonly played specific sports was also recorded as a binary variable. A strong association exists between playing baseball and ST use, and this variable and other sports were included in the analyses (Ernster et al., 1990).

Data Analysis

We described the sample via univariate frequency tables, followed by comparisons between dual users (one product daily and one nondaily) and the exclusive users of only one tobacco

product. Similar to prior studies (Haddock et al., 1998), we first compared daily cigarette smokers who also used ST (daily smokers/nondaily ST users) to exclusive daily cigarette smokers using univariate logistic regressions. All variables with $p < .10$ in univariate regressions were included in backwards stepwise multivariate logistic regressions to describe correlates of dual use, controlling for demographic factors. Instead of a single multinomial analysis, for ease of interpretation, we performed a series of logistic regressions to fit the analyses most appropriate to clinical scenarios (i.e., if airmen are daily smokers, are there significant attitudinal differences or risks if they also use ST? Or, if airmen are daily ST users, are there significant differences in attitudes or risk if they also smoke cigarettes?). After comparing daily smokers to daily smokers/nondaily ST users, we followed the same procedures to compare exclusive ST users to daily ST users who smoked cigarettes nondaily.

We then compared daily users of both cigarettes and ST to dual users of one product daily and the other product nondaily (two groups, daily cigarette smokers/nondaily ST users and daily ST users/nondaily cigarette smokers). For these two analyses, we also used univariate logistic regressions followed by backwards stepwise multivariate logistic regressions. All demographic factors (age, education, race/ethnicity, marital status, and region) were included in final multivariate models. Data analyses were performed using IBM SPSS Statistics for Windows, Version 21.0 (International Business Machines Corporation).

RESULTS

Sample Composition

In this sample of 8,956 participants, the proportion reporting current cigarette smoking was 22.5% and daily smoking (including both smokers not using ST and dual users) was 9.3%. The proportion reporting current ST use was 14.5% and daily ST use was 6.2%. Daily exclusive cigarettes smokers were 5.4% ($n = 483$) of the total sample, daily exclusive ST users were 2.7% ($n = 241$), daily smokers/nondaily ST users were 1.3% ($n = 115$), daily ST users/nondaily smokers were 1.1% ($n = 94$), and daily smokers/daily ST users were 1.1% ($n = 97$). Table 1 presents the sample characteristics and frequencies for measures used in subsequent univariate and multivariate regressions.

Dual Users of Cigarettes and ST Compared to Exclusive Daily Smokers and Exclusive Daily ST Users

The first two analyses compared Airmen who were exclusive daily smokers or exclusive daily ST users with Airmen who used the same product daily (e.g., ST) but also used the other product nondaily (i.e., weekly or monthly) (Table 2).

Daily Smokers/Nondaily ST Users Versus Exclusive Daily Smokers

Dual users (daily smokers/nondaily ST users) were more likely than exclusive cigarette smokers to be male and expected to use ST and multiple forms of tobacco in the future. Dual users were also more likely to report that more than half of their friends used ST and that more than half of their friends used

both ST and cigarettes. Dual users were also more likely to own items with both cigarette and ST advertising. Finally, dual users had more than double the odds of having played baseball in high school or college.

Daily ST Users/Nondaily Cigarette Smokers Versus Exclusive ST Users

The multivariate analysis compared male (females were excluded due to low prevalence of ST use) dual users (daily ST users/nondaily smokers) to exclusive daily ST users (Table 2). Dual users (daily ST users/nondaily smokers) were more likely to live in the Midwest and, similar to the above analyses with cigarette smokers, indicated that they intend to use multiple forms of tobacco in the future. Dual users were more likely to state that more than half of their friends smoke cigarettes and use both cigarettes and ST. Finally, these dual users reported that they would consider a tobacco product that claims to be safer than cigarettes.

Daily Users of Both Cigarettes and ST Compared to Daily/Nondaily Dual Users

We compared daily users of both ST and cigarettes with daily users of one product and nondaily use of the other, namely daily cigarette users/nondaily ST users and daily ST users/nondaily cigarette smokers. Note that both analyses present predictors of daily dual use (being a daily user of both cigarettes and ST) compared to each type of intermittent dual user (Table 3).

Daily Smokers/Daily ST Users Versus Daily Smokers/Nondaily ST Users

Compared to daily cigarette users/nondaily ST users, daily users of both cigarettes and ST had significantly greater odds of nicotine dependence. They were significantly more likely to report that they would use ST in the future but were significantly less likely to expect to use cigarettes in the future than daily smokers/nondaily ST users.

Daily Smokers/Daily ST Users Versus Daily ST Users/Nondaily Smokers

Daily users of both ST and cigarettes were significantly less likely to report that they would use ST in the future than daily ST users who smoke cigarettes nondaily. Daily smokers/daily ST users were also significantly more likely to have higher nicotine dependence scores. Additionally, daily smokers/daily ST users were more likely to indicate that at least half of their close friends smoke, but they were significantly less likely than dual users, who use ST daily and cigarettes nondaily, to agree that ST is safer than cigarettes. Finally, daily smokers/daily ST users were more likely to indicate that they would use tobacco to pass mandatory physical fitness standards than nondaily dual users (significantly more than daily ST/nondaily smokers, and marginally significantly more than daily smokers/nondaily ST users).

DISCUSSION

The results of the current study suggest that risk factors for continued tobacco use increase as a function of both whether two tobacco products are being concomitantly used as well as

Table 1. Demographic Characteristics and Attitudes Among Daily Smokers, Smokeless Tobacco Users, and Dual Users

	Exclusive daily smokers (<i>N</i> = 483) (%)	Exclusive daily ST users (<i>N</i> = 241) (%)	Daily smokers/ nondaily ST users ^a (<i>N</i> = 115) (%)	Daily ST users/ nondaily smokers ^a (<i>N</i> = 94) (%)	Daily smokers/ daily ST users (<i>N</i> = 97) (%)
≥21 years	186 (38.5)	79 (32.8)	36 (31.3)	27 (28.7)	16 (16.5)
Male	334 (69.2)	236 (97.9)	108 (93.9)	92 (97.9)	96 (99.0)
More than high school education	192 (39.8)	103 (42.7)	39 (33.9)	41 (43.6)	26 (26.8)
Race/ethnicity					
Non-Hispanic White	353 (73.7)	216 (91.1)	96 (85.0)	80 (86.0)	85 (87.6)
Non-Hispanic African American	41 (8.6)	5 (2.1)	1 (0.9)	1 (1.1)	1 (1.0)
Hispanic	41 (8.6)	8 (3.4)	10 (8.8)	4 (4.3)	9 (9.3)
Other	44 (9.2)	8 (3.4)	6 (5.3)	8 (8.6)	2 (2.1)
Overweight or obese	117 (24.7)	74 (31.1)	29 (25.7)	38 (40.4)	33 (35.1)
Nicotine dependence					
Minimal	251 (54.8)	125 (56.6)	53 (48.6)	48 (51.6)	27 (28.7)
Moderate	173 (37.8)	76 (34.4)	47 (43.1)	37 (39.8)	61 (64.9)
Highly	34 (7.4)	20 (9.0)	9 (8.3)	8 (8.6)	6 (6.4)
Expects to smoke cigarettes in the future	298 (90.9)	0 (0.0)	41 (44.6)	1 (1.2)	9 (11.3)
Expects to use ST in the future	3 (0.9)	186 (97.4)	13 (14.1)	66 (79.5)	33 (41.3)
Will use multiple forms of tobacco in the future	27 (8.2)	5 (2.6)	38 (41.3)	16 (19.3)	38 (47.5)
Will use tobacco occasionally after Tech School to meet mandatory military physical fitness standards	155 (32.2)	80 (33.2)	47 (40.9)	32 (34.0)	51 (53.1)
More than half of friends smoke cigarettes	337 (69.8)	49 (20.3)	84 (73.0)	44 (46.8)	71 (73.2)
More than half of friends use ST	51 (10.6)	149 (61.8)	42 (36.5)	63 (67.0)	52 (53.6)
More than half of friends use ST and smoke cigarettes	91 (18.9)	73 (30.3)	61 (53.0)	51 (54.3)	52 (53.6)
Agrees ST is safer than cigarettes	23 (4.8)	98 (40.7)	18 (15.7)	38 (40.4)	16 (16.5)
Owens an item with cigarette advertising	36 (7.5)	12 (5.0)	19 (16.5)	10 (10.6)	10 (10.3)
Owens an item with ST advertising	4 (0.8)	50 (20.8)	11 (9.6)	23 (24.5)	12 (12.4)
Played baseball in either high school or college	275 (56.9)	214 (88.8)	87 (75.7)	80 (85.1)	74 (76.3)

Note. ST = smokeless tobacco.

^aNondaily ST users and smokers used the tobacco product at least weekly or monthly.

the frequency with which the products are consumed (daily vs. nondaily). Relative to exclusive daily smokers, those who are daily smokers/nondaily ST users are much more likely to intend to continue using tobacco, with over 20 times greater odds to expect to use ST in the future, and over 10 times greater odds to predict they will use multiple forms of tobacco in the future. Similar to other ST users, daily smokers who also used ST are more likely to be male and to report more peer contexts conducive to ST use: more friends using ST and cigarettes, and more likely to have played baseball in high school or college. They are also more receptive to advertising for both cigarettes and ST. Relative to exclusive daily ST users, daily ST users/nondaily cigarette users are also more likely to report they intend to use multiple forms of tobacco in the future. Peer behavior is also important. The dual users are more likely to state that more than half of their friends smoke cigarettes and that they have more friends who use both cigarettes and ST. Daily dual users (daily use of both cigarettes and ST) also differ along several dimensions, the most prominent being higher levels of nicotine dependence, and a greater likelihood of intending to use tobacco to maintain military weight standards.

The data from this study support three general conclusions. First, even infrequent dual users are markedly different than tobacco users who use just cigarettes or ST. It is particularly concerning that the cigarette smokers who use ST nondaily have 20 times greater odds of reporting use of ST in the future and 10 times greater odds of reporting that they will use both types of products in the future. Additionally, daily ST users who use cigarettes on a nondaily basis have over 7 times greater odds of reporting that they will use multiple forms of tobacco in the future. Thus, our data support the notion that tobacco users who use a second tobacco product even on a nondaily basis have markedly different behavioral risk profiles than those who either smoke cigarettes or use ST exclusively. To our knowledge, this is the first study to evaluate different subtypes of dual users, and significant differences among subtypes were observed.

The second conclusion is that dual users have a much higher risk factor profile, and the data support the idea that targeted interventions for these high-risk groups are warranted. As indicated above, even casual users of a second tobacco product have much higher risk profiles for continued tobacco use. It also appears that dual users that use both products daily are at

Table 2. Multivariate Analyses Comparing (a) Daily Smokers/Nondaily ST Users vs. Exclusive Daily Smokers and (b) Daily ST Users/Nondaily Smokers vs. Exclusive Daily ST Users^a

	Daily smokers/nondaily ST users vs. exclusive daily smokers (N = 571), AOR (95% CI)	Daily ST users/nondaily smokers vs. exclusive daily ST users ^b (N = 312), AOR (95% CI)
≥21+ years	1.02 (0.56, 1.85)	0.82 (0.37, 1.84)
Male	7.01 (2.78, 17.70)***	
More than high school education	1.13 (0.62, 2.07)	1.42 (0.70, 2.89)
Race/ethnicity [$\chi^2(3) = 4.27, p = .235$]		
Non-Hispanic White	Reference	Reference
Non-Hispanic African American	0.12 (0.02, 0.94)*	1.35 (0.14, 13.60)
Hispanic	0.98 (0.37, 2.62)	1.50 (0.36, 6.23)
Other	0.75 (0.26, 2.23)	3.71 (0.88, 15.80)
Marital status, unmarried	0.84 (0.33, 2.13)	0.55 (0.18, 1.62)
Regions ($\chi^2(3) = 0.80, p = .85$)		
South	Reference	Reference
West	1.13 (0.46, 2.76)	1.03 (0.04, 2.65)
Northeast	0.98 (0.45, 2.13)	0.97 (0.36, 2.57)
Midwest	1.32 (0.68, 2.56)	2.60 (1.31, 5.14)**
Will use multiple forms of tobacco in the future	10.7 (5.22, 22.10)***	7.34 (2.20, 24.50)**
More than half of friends use ST and smoke cigarettes	4.55 (2.44, 8.49)***	2.17 (1.18, 3.98)*
Expects to use ST in the future	22.2 (4.08, 120.60)***	—
More than half of friends use ST	2.45 (1.20, 5.01)*	—
Owens an item with cigarette advertising	2.73 (1.17, 6.42)*	—
Owens an item with ST advertising	5.10 (1.11, 23.40)*	—
Played baseball in high school or college	2.95 (1.36, 6.37)**	—
More than half of friends smoke cigarettes	—	3.61 (1.94, 6.72)***
Would try tobacco product that claims to be safer than cigarettes	—	2.92 (1.36, 5.23)***

Note. ST = smokeless tobacco; AOR = adjusted odds ratio; CI = confidence interval.

^aUnivariate analyses were performed for all variables (data not shown), and all variables associated with dual use with $p < .10$ were entered into multivariate backwards stepwise logistic regressions; final models retained only variables with $p < .05$. All multivariate analyses are adjusted for demographic explanatory variables.

^bAnalysis limited to males due to very small numbers of female daily ST users.

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

even more high risk than dual users who use one product on a nondaily basis. For example, daily dual users have significantly greater odds relative to nondaily dual users for having higher levels of nicotine dependence. These data suggest that daily dual users have higher risk profiles than nondaily dual users who, in turn, have much higher risk profiles than exclusive cigarette smokers or exclusive ST users. In addition, dual use may have more serious health consequences than use of a single product: an international standardized case-control study with 27,089 participants found that dual use significantly increased the risk of acute myocardial infarction compared to either smoking alone or exclusive ST use (Teo et al., 2006). The combination of more nicotine dependence and future intent to use tobacco products suggests that targeted, more aggressive interventions may be warranted. Future studies should test interventions for dual users, as their high-risk profile argues in favor of targeted interventions, particularly dual users that use both products daily. Daily dual users' propensity to use tobacco to pass mandatory physical fitness standards might be one avenue to explore for intervention.

The third and final conclusion is that dual users are a heterogeneous group. In a previous paper, we argued that dual users should be defined by daily use of one product (ST, cigarettes) and at least weekly use of another (Klesges et al., 2011). This study

indicates that risk profiles vary as a function of both whether they are using a second tobacco product as well as the frequency of its use. As more new and emergent products become available on the market (e.g., e-cigarettes, snus), the literature may need to adapt operational definitions of dual use and what constitutes concomitant use of various tobacco products.

Our study has several limitations. First, we surveyed new recruits of only one Service branch in the U.S. military. Sampled Airmen were transitioning from BMT to Technical Training, so they do not represent all Airmen. These Airmen are likely more similar to trainees across Services than they are to the Air Force at large. All new trainees largely share the same, although not exact, risk factors for tobacco use. They are young, predominantly male and minorities, and grew up in low-income families (Ebbert et al., 2006; Smith & Malone, 2009). Differences exist between military branches with respect to demographics, tobacco control climate, and patterns of tobacco use. However, none of the sampled Airmen have yet been enculturated to any particular Service branch at this level of training. Many training schools conduct joint service activities with Army, Navy, and Air Force trainees living and working in the same environment immediately following BMT; however, Airmen in the current study were assessed during their transition week between BMT and Technical Training. Air Force Technical Training in San

Table 3. Analyses of (a) Daily Smokers/Daily ST Users vs. Daily Smokers/Nondaily ST Users and (b) Daily Smokers/Daily ST Users vs. Daily ST Users/Nondaily Smokers^a

	Daily smokers/daily ST users vs. daily smokers/nondaily ST users (N = 191), AOR (95% CI)	Daily smokers/daily ST users vs. daily ST users/nondaily smokers (N = 182), AOR (95% CI)
≥21 years	0.71 (0.29, 1.72)	0.70 (0.23, 2.13)
More than high school education	0.89 (0.41, 1.94)	0.58 (0.24, 1.43)
Race/ethnicity	<i>p</i> = .60	<i>p</i> = .92
Non-Hispanic White	Reference	Reference
Non-Hispanic African American	5.54 (0.14, 216.12)	1.03 (0.02, 45.16)
Hispanic	0.57 (0.17, 1.95)	1.54 (0.18, 13.55)
Other	0.62 (0.08, 4.80)	0.57 (0.08, 3.92)
Marital status, unmarried	0.55 (0.17, 1.75)	0.47 (0.12, 1.89)
Regions	<i>p</i> = .75	<i>p</i> = .281
South	Reference	Reference
West	1.43 (0.45, 4.58)	0.82 (0.22, 3.14)
Northeast	0.98 (0.37, 2.57)	1.51 (0.45, 5.02)
Midwest	1.50 (0.64, 3.49)	0.49 (0.19, 1.25)
Nicotine dependence	<i>p</i> = .021	<i>p</i> = .038
Minimal	Reference	Reference
Moderate	2.72 (1.32, 5.62)**	2.84 (1.26, 6.43)*
Highly	2.97 (0.67, 13.13)	1.29 (.29, 5.70)
Expects to use ST in the future	2.84 (1.22, 6.66)*	0.16 (0.07, 0.35)***
Will use tobacco occasionally after Tech School to meet mandatory military physical fitness standards	2.05 (0.99, 4.25)	2.69 (1.21, 5.96)*
More than half of friends use ST	1.79 (0.906, 3.55)	0.42 (0.18, 1.01)
Expects to smoke cigarettes in the future	0.15 (0.05, 0.42)***	—
More than half of friends smoke cigarettes	—	3.89 (1.56, 9.68)**
Agrees ST is safer than cigarettes	—	0.33 (0.13, 0.83)*

Note. ST = smokeless tobacco; AOR = adjusted odds ratio; CI = confidence interval.

^aThe main outcome group (daily smokers/daily ST users) is the same for both analyses, but the reference group is different in each column. All analyses are limited to males due to very small numbers of female daily ST users in the sample.

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

Antonio, TX, conducts about 25% of all Air Force Technical Training. Some Airmen can preselect for a specific skills training before entering the Air Force, but many enter as “open general,” meaning that they will be placed where open positions exist. While not random assignments, similarities between these trainees for the purposes of assessing the risk of tobacco use are more similar than different. Our results are most generalizable to Airmen trained in San Antonio, TX, who become military training instructors, security police, military working dog handlers, hazardous materials operations technicians, pararescuers, explosive ordinance disposal specialists, and combat controllers. We are currently collecting tobacco use information at two additional training locations, comprising approximately 80% of all Air Force trainees and will soon be able to answer the question of generalizability across Airmen who are placed or select different specialties. Second, as is the case with most survey studies, our reports of tobacco are limited to self-reporting of tobacco status. Third, we were only able to assess the dual use of ST and cigarettes. Future studies should focus on not only dual use of ST and cigarettes but also combinations of more traditional tobacco products with new and emerging products (e.g., the concomitant use of both cigarettes and e-cigarettes).

In summary, our data suggest that dual users display a heterogeneous risk profile with risk increasing as a function of not only whether a second tobacco product is being used but also the frequency with which the second product is being used

(e.g., daily or nondaily). High priority should be given to the development of interventions to treat this high-risk population.

SUPPLEMENTARY MATERIAL

Supplementary Appendix A can be found online at <http://www.ntr.oxfordjournals.org>

FUNDING

This work was supported by the National Cancer Institute (CA141567 and CA141567-04S1 to RCK), the National Institute of Drug Abuse (DA036510 and DA036510-S2 to RCK), and the National Cancer Institute (CA141661 to PML). The study was also supported by the UCSF School of Medicine Dean's Office Medical Student Research Program. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

DECLARATION OF INTERESTS

JOE has received personal fees from GlaxoSmithKline and research support from Pfizer, Orexigen, and JHP Pharmaceuticals outside of the current study.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the support of the 2nd Air Force, the leadership branch for training in the U.S. Air Force. The opinions expressed in this document are solely those of the authors and do not represent an endorsement by or the views of the U.S. Air Force, the U.S. Department of Defense, or the U.S. government.

REFERENCES

- Agaku, I. T., Ayo-Yusuf, O. A., Vardavas, C. I., Alpert, H. R., & Connolly, G. N. (2013). Use of conventional and novel smokeless tobacco products among US adolescents. *Pediatrics*, 132, e578–e586. doi:10.1542/peds.2013-0843
- Bhattacharyya, N. (2012). Trends in the use of smokeless tobacco in United States, 2000–2010. *The Laryngoscope*, 122, 2175–2178. doi:10.1002/lary.23448
- Boffetta, P., Hecht, S., Gray, N., Gupta, P., & Straif, K. (2008). Smokeless tobacco and cancer. *The Lancet Oncology*, 9, 667–675. doi:10.1016/S1470-2045(08)70173-6
- Bombard, J. M., Rock, V. J., Pederson, L. L., & Asman, K. J. (2008). Monitoring polytobacco use among adolescents: Do cigarette smokers use other forms of tobacco? *Nicotine and Tobacco Research*, 10, 1581–1589. doi:10.1080/14622200802412887
- Bondurant, S., & Wedge, R. (Eds.). (2009). *Combating tobacco use in military and veteran populations*. Washington, DC: The National Academies Press. Retrieved from http://www.nap.edu/catalog.php?record_id=12632
- Bray, R. M., Pemberton, M. R., Hourani, L. L., Witt, M., Rae Olmsted, K. L., Brown, J. M., ... Bradshaw, M. (2009). *2008 Department of Defense Survey of Health Related Behaviors Among Active Duty Military Personnel. A component of the Defense Lifestyle Assessment Program (DLAP)* (pp. 1–678). Research Triangle Park, NC: RTI International.
- Centers for Disease Control and Prevention (CDC). (2011). Healthy weight – it's not a diet, it's a lifestyle! About BMI for adults. Retrieved from http://www.cdc.gov/healthy-weight/assessing/bmi/adult_bmi/index.html
- Clinton, W. J. (1997). Protecting federal employees and the public from exposure to tobacco smoke in the federal workplace. *Federal Register*, 62, 43451–43452. Executive Order 13058. The White House Office of the Press Secretary. Retrieved from <http://clinton6.nara.gov/1997/08/1997-08-09-executive-order-13058-on-smoking-in-federal-workplaces.html>
- Ebbert, J. O., Haddock, C. K., Vander Weg, M., Klesges, R. C., Poston, W. S., & DeBon, M. (2006). Predictors of smokeless tobacco initiation in a young adult military cohort. *American Journal of Health Behavior*, 30, 103–112. doi:10.5555/ajhb.2006.30.1.103
- Ebbert, J. O., Patten, C. A., & Schroeder, D. R. (2008). The Fagerström test for nicotine dependence-smokeless tobacco (FTND-ST). *Addictive Behaviors*, 31, 1716–1721. doi:10.1016/j.addbeh.2005.12.015
- Ernster, V. L., Grady, D. G., Greene, J. C., Walsh, M., Robertson, P., Daniels, T. E., ... Hauck, W. W. (1990). Smokeless tobacco use and health effects among baseball players. *JAMA: The Journal of the American Medical Association*, 264, 218–224. doi:10.1001/jama.1990.03450020070029.
- Fagerström, K., & Eissenberg, T. (2012). Dependence on tobacco and nicotine products: A case for product-specific assessment. *Nicotine and Tobacco Research*, 14, 1382–1390. doi:10.1093/ntr/nts007
- Ferketich, A. K., Wee, A. G., Shultz, J., & Wewers, M. E. (2007). A measure of nicotine dependence for smokeless tobacco users. *Addictive Behaviors*, 32, 1970–1975. doi:10.1016/j.addbeh.2007.01.005
- Haddock, C. K., Klesges, R. C., Talcott, G. W., Lando, H., & Stein, R. J. (1998). Smoking prevalence and risk factors for smoking in a population of United States Air Force basic trainees. *Tobacco Control*, 7, 232–235. doi:10.1136/tc.7.3.232
- Harris, K. (August 31, 2010). Air Force bans electronic cigarettes from the workplace, Stars and Stripes. Retrieved from <http://www.stripes.com/news/air-force-bans-electronic-cigarettes-from-the-workplace-1.116534>
- Heatherton, T. F., Kozlowski, L. T., Frecker, R. C., & Fagerström, K. O. (1991). The Fagerström test for nicotine dependence: A revision of the Fagerström Tolerance Questionnaire. *British Journal of Addiction*, 86, 1119–1127. doi:10.1111/j.1360-0443.1991.tb01879.x
- Henley, S. J., Thun, M. J., Connell, C., & Calle, E. E. (2005). Two large prospective studies of mortality among men who use snuff or chewing tobacco (United States). *Cancer Causes & Control: CCC*, 16, 347–358. doi:10.1007/s10552-004-5519-6
- Klesges, R. C., Ebbert, J. O., Morgan, G. D., Sherrill-Mittleman, D., Asfar, T., Talcott, W. G., & DeBon, M. (2011). Impact of differing definitions of dual tobacco use: Implications for studying dual use and a call for operational definitions. *Nicotine and Tobacco Research*, 13, 523–531. doi:10.1093/ntr/ntr032
- Smith, E. A., & Malone, R. E. (2009). “Everywhere the soldier will be”: Wartime tobacco promotion in the US military. *American Journal of Public Health*, 99, 1595–1602. doi:10.2105/AJPH.2008.152983
- Stockwell, H. G., & Lyman, G. H. (1986). Impact of smoking and smokeless tobacco on the risk of cancer of the head and neck. *Head and Neck Surgery*, 9, 104–110. doi:10.1002/hed.2890090206
- Teo, K. K., Ounpuu, S., Hawken, S., Pandey, M. R., Valentin, V., Hunt, D., ... INTERHEART Study Investigators. (2006). Tobacco use and risk of myocardial infarction in 52 countries in the INTERHEART study: A case-control study. *Lancet*, 368, 647–658. doi:10.1016/S0140-6736(06)69249-0
- U.S. Census Bureau. (2014). Census Regions and Divisions of the United States. Retrieved from http://www.census.gov/geo/maps-data/maps/pdfs/reference/us_regdiv.pdf