A longitudinal analysis of tobacco use in younger and older U.S. veterans

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ABSTRACT

United States (U.S.) veterans are prone to higher rates of smoking and smoking-related disease. We describe the prevalence of cigarette and non-cigarette product use and determine longitudinal predictors of tobacco use transitions in this vulnerable population.

Data are from Waves 1 (2013–2014) and 2 (2014–2015) of the adult cohort in the Population Assessment of Tobacco and Health. Wave 1 prevalence was calculated for past 30-day use of all queried tobacco products, and compared by veteran status. Weighted multinomial logistic regression was used to determine predictors—demographics, substance use, and physical and psychological comorbidities—of tobacco use transitions (continued use, initiation, and cessation) among veterans.

Compared to non-veterans, use of nearly all tobacco products was significantly higher among veterans and was highest among younger veterans. Compared to continued nonusers, continued users were more likely to: be of younger age (OR = 0.95, 95% CI: 0.95–0.96), have poorer physical health (OR = 1.58, 95% CI: 1.22–2.06) and mental health (OR = 1.48, 95% CI: 1.18–1.85), report substance use (OR = 1.79, 95% CI: 1.21–2.64), and report problematic alcohol use (OR = 4.23, 95% CI: 2.38–7.52) and were less likely to be female (OR = 0.57, 95% CI: 0.35–0.93). Compared to continued nonusers, initiators were more likely to report problematic alcohol use (OR = 8.63, 95% CI: 3.79–19.63), and those in the cessation category were more likely to be of younger age (OR = 0.97, 95% CI: 0.95–0.99).

Cigarette and non-cigarette use is especially prevalent among young veterans, so prevention should begin during military service. Tobacco cessation programs should be tailored for this population, incorporating aspects related to concomitant health conditions.

1. Introduction

Tobacco use remains the largest preventable cause of death in the U.S. (US Department of Health and Human Services, 2014), and it is well-documented that individuals who have served in the military have higher rates of smoking and smoking-related diseases than the U.S. population in general. Healthcare costs for the U.S. Veterans Administration (VA) are high. In 2017, they were nearly $70 billion (US Department of Veterans Affairs, 2017), although this number does not represent the actual cost of medical care for all veterans, many of whom receive care outside of the VA healthcare system. In addition, a disproportionate share of VA healthcare expenditures are from patients with multiple chronic conditions (Yoon et al., 2014). Tobacco use represents a preventable risk factor associated with a number of chronic health conditions like cancer, hypertension, heart disease and stroke.

Younger veterans may represent a particularly vulnerable group to tobacco use. In an analysis using data from the 2003–2007 Behavioral Risk Factor Surveillance System (BRFSS), it was found that among veterans, the prevalence of cigarette smoking was highest among those born between 1975 and 1989 (Brown, 2010). In addition, qualitative research has shown that younger veterans—those who served during the conflicts in Afghanistan and Iraq like Operation Enduring Freedom (OEF) or Operation Iraqi Freedom (OIF)—report smoking as endemic in military service and identify several environmental and situational barriers to smoking cessation (Gierisch et al., 2012). Similar barriers were described in another qualitative study of Army and Air Force enlisted personnel who reported that the military culture accommodates smoking with prevalent smoking breaks and smoking areas and inexpensive tobacco products sold on military bases (Haddock et al., 2009). Among young adult newly enlisted military personnel, military role models who use tobacco, peer smoking behavior and perceived smoking norms were associated with higher odds of smoking

initiation (Green et al., 2008).

Some studies have begun to document non-cigarette tobacco products among active duty military populations, although prevalence of non-cigarette product use among veterans is largely unknown. Studies examining non-cigarette use among active duty military have shown relatively high prevalence of cigar, smokeless tobacco, hookah and electronic nicotine delivery systems (ENDS) use (Linde et al., 2015; Little et al., 2016, 2015; Vander Weg et al., 2008).

Physical and psychological comorbidities are high among U.S. veterans, and evidence suggests these conditions often co-occur with tobacco use, particularly among those who have served in combat. In combat veterans with PTSD for example, heavy smoking was associated with total health complaints, health complaints in the past year, negative health behaviors, and total PTSD symptoms (Beckham et al., 1997). Another study showed veterans reported using cigarettes to cope with pain; there was a greater occurrence of pain and disability among smokers in the military, and smoking increased the odds of veterans receiving opioids for pain and misusing opioids (Chapman and Wu, 2015). Vietnam veterans with PTSD who smoked reported higher levels of PTSD symptoms, depression and anxiety than those who did not smoke (Beckham et al., 1995). Moreover, in a study of OEF/OIF veterans, it was found that 29% reported chronic pain and more than half screened positive for mental health and substance use disorders (PTSD: 53%; depression: 60%; alcohol misuse: 63%) (Helmer et al., 2009).

This manuscript aims to provide information on how cigarette and non-cigarette tobacco products are used among U.S. veterans (including younger veterans), a population prone to higher rates of cigarette use, but for which non-cigarette use is not well understood. To date, no other studies have drawn from nationally-representative datasets to describe tobacco use behaviors and transitions which include the use of non-cigarette products, such as ENDS, cigars and hookah, among U.S. veterans. While previous studies in the veteran population have primarily focused on documenting patterns of cessation among current smokers (Malte et al., 2015; McFall et al., 2005), few have additionally documented transitions between no use to use in this group. The proposed study will fill a significant gap in the literature by describing the prevalence and predictors of cigarette and non-cigarette (hookah, smokeless tobacco, ENDS, cigar) product use among U.S. veterans with a longitudinal, observational study design. The manuscript has two objectives. First, we describe the prevalence of cigarette and non-cigarette product use, comparing veterans to non-veterans. Second, we determine predictors—particularly age, sex, race/ethnicity, substance use behaviors, and physical and psychological comorbidities—of tobacco use transitions (continued use, initiation, and cessation) across time using a subsample of U.S. veterans.

2. Methods

2.1. Data source

Data were drawn from Wave 1 (2013–2014) and Wave 2 (2014–2015) of the Population Assessment of Tobacco and Health (PATH) Study, a nationally representative, longitudinal cohort of youth and adults in the U.S. The PATH study aims to identify and characterize tobacco use behaviors, attitudes and beliefs, and tobacco-related health outcomes among an estimated 46,000 U.S. adults and youth. The PATH sampling frame draws users and non-users of tobacco products in the civilian, non-institutionalized household population of the U.S.

The PATH study uses a four-staged stratified sampling design. The study sampled over 150,000 mailing addresses which yielded a sample of 45,971 respondents (32,320 adults and 13,651 youth) who completed the Wave 1 interview. Tobacco users and non-users who were at least 12 years old living in a civilian, non-institutionalized setting were considered for participation during Wave 1. The household screener response rate was 54.0%, and the adult interview response rate was 74.0% for Wave 1. The adult interview weighted retention rate was

83.1%. Survey weights were calculated based on the complex survey design and account for oversampling of certain population groups and non-response. This study used the restricted use data files for adults available from the National Addiction & HIV Data Archive Program (NAHDAP) (US Department of Health and Human Services, 2017).

2.2. Measures

The PATH survey collects information related to seven types of tobacco products, including cigarettes, ENDS, cigars (traditional, cigarillos, filtered), pipes, hookah, smokeless tobacco (snus pouches and other forms of smokeless tobacco), and dissolvable tobacco. The current study focuses primarily on veteran status, demographic characteristics, and tobacco use behaviors. Other risk factors which are prevalent among U.S. veterans, such as use of other substances and psychological or physical comorbidities (Chapman and Wu, 2015; Hefner et al., 2016), are explored in this paper as correlates of tobacco transitions between Waves 1 and 2.

Veteran status. Participants were asked "Have you ever served on active duty in the U.S. Armed Forces, Military Reserves or National Guard?" at Wave 1. For Reserves or National Guard members, active duty included being activated for deployment, but did not include regular Reserves or National Guard training. Those who answered "Yes, on active duty in the past, but not now" were included in our analytic sample.

Branch of service. Participants who indicated veteran status were asked, "In which branch or branches did you serve on active duty?" Response options were "Army", "Navy", "Air Force," "Marine Corps," and "Coast Guard."

Conflict served. Participants who indicated veteran status were asked, "When did you serve on active duty in the U.S. Armed Forces?" Response options were "September 2001 or later," "August 1990 to August 2001 (including Persian Gulf War)," "September 1980 to July 1990," "May 1975 to August 1980," "Vietnam era (August 1964 to April 1975)," "March 1961 to July 1964," "February 1955 to February 1961," "Korean War (July 1950 to January 1955)," "January 1947 to June 1950," "World War II (December 1941 to December 1946)," and "November 1941 or earlier." Due to small sample size, those who served during February 1961 or earlier were collapsed into one category for analysis.

Demographic characteristics. Demographic variables included age (a continuous variable), sex and race/ethnicity. Race/ethnicity was treated as a dichotomous variable, coded as non-Hispanic White and non-White (a collapsed category made up of Hispanic, African-American or Black, Asian, American-Indian or Alaskan Native and other or multi-race categories) due to small sample size in each non-White group.

Current tobacco use. At Waves 1 and 2, participants were asked about past 30-day tobacco use, even one or two times, for the following tobacco products: cigarettes, ENDS, traditional cigars, cigarillos, filtered cigars, pipe tobacco, hookah, smokeless tobacco (i.e. loose snus, moist snuff, dip, spit, or chewing tobacco), snus pouches and dissolvable tobacco. Current tobacco use was operationalized as a dichotomous variable. Participants who reported using any product in the past 30 days were categorized as "current users" and coded as 1. Participants who did not use any products were categorized as "non-users" in the past 30 days and coded as 0. "Any current tobacco" use was defined as current use of any tobacco product.

Tobacco use transitions. Tobacco use transitions served as the dependent variables for the multinomial regression analysis. While tobacco use categories have been examined in diverse ways in the literature, we categorized Wave 1 and 2 respondents in the following four trajectories, similar to Talcott et al. (2013): (1) continued non-use; (2) continued use; (3) initiation; (4) cessation. Respondents who are classified as continued non-users did not use tobacco at either wave. Those who are continued users have used any tobacco product at both waves.

Respondents in the initiation category have transitioned from no tobacco use in Wave 1 to any tobacco use in Wave 2. Respondents who are classified in the cessation trajectory have transitioned from any tobacco use in Wave 1 to no tobacco use in Wave 2.

Substance use. Participants were asked if they had ever used the following substances: marijuana, prescription drugs that were not prescribed to them (Ritalin®, Adderall®, painkillers, sedatives or tranquilizers), cocaine or crack, stimulants (methamphetamine or speed), heroin, inhalants, solvents and hallucinogens. Participants who reported ever using of any of these substances/groups of substances were asked how long it had been since their last use. Participants who reported using any of the substances/groups of substances at least once during the past year (at Wave 2) were considered "past year users."

Alcohol use. Participants who reported consuming alcohol in the past 30 days in Wave 2 were asked the number of alcoholic drinks usually consumed each day on the days they drank. Females who reported an average of ≥ 4 alcohol drinks per day; and males who reported ≥ 5 alcohol drinks on days they drank in the past 30 days were labelled as "problematic alcohol users." This definition of problematic alcohol use was based on the National Institute on Alcohol Abuse and Alcoholism definitions of binge drinking (National Institute on Alcohol Abuse and Alcoholism, 2019).

Physical health. Physical and mental health was assessed using the Patient-Reported Outcome Measurement Information System (PROMIS) scale. The PROMIS scale, which has been previously validated, measures general perceptions about physical and mental health (Hays et al., 2009). Participants were administered the 4-item PROMIS physical health scale at Wave 1. All items were scored on a scale from 1 to 5, where 1 represented excellent and 5 was poor. The item on pain, which was originally a scale from 1 to 10, was re-coded to represent this 5-item scale. These items assessed overall physical health ("In general, how would you rate your physical health?"); physical function ("To what extent are you able to carry out your everyday physical activities such as walking, climbing stairs, carrying groceries, or moving a chair?"); pain ("In the past 7 days, how would you rate your pain on average on a scale from 0 to 10 where 0 is no pain and 10 is the worst pain imaginable?"); and fatigue ("In the past 7 days, how would you rate your fatigue on average? By fatigue, we mean feeling unrested or overly tired during the day, no matter how many hours of sleep you've had."). The overall PROMIS scale score was calculated as an average (alpha = 0.72), with higher scores representing poorer physical health.

Mental health. To assess general perceptions of mental health, participants were administered the 4-item PROMIS mental health scale at Wave 1. Each item was scored from 1 to 5, where 1 represented excellent and 5 was poor. These items assessed quality of life ("In general would you say your quality of life is…."); mental health ("In general, how would you rate your mental health, which includes stress, depression, and problems with emotions?"); satisfaction with social activities ("In general, how satisfied are you with your social activities and relationships?"); and emotional problems ("In the past 7 days, how often have you been bothered by emotional problems such as feeling anxious, depressed, or irritable?"). Again, the overall PROMIS scale score was calculated as an average (alpha = 0.81) with higher scores representing poorer mental health.

2.3. Statistical analyses

First, Wave 1 prevalence estimates of tobacco use were calculated for current (past 30-day) use across all tobacco products, and compared by veteran status. Since the veteran participants in PATH were older (mean = 60.1 years) and had a larger proportion of males (92.9%) than the non-veteran participants, prevalence estimates of tobacco use were calculated as adjusted predictions at the means—i.e., the prevalence was calculated assuming the mean values of age and sex (Williams, 2012). Post-hoc contrast comparisons and their associated chi-square *p*-values were calculated to test for statistically significant differences

between veteran and non-veteran groups. To compare tobacco use among veterans and non-veterans by age, estimated probabilities of past 30-day any tobacco use, adjusted for mean age and gender, were plotted by age (20–90 years). We then inspected the non-overlapping confidence intervals to determine if estimates between veterans and non-veterans were statistically different. In these analyses, Wave 1 survey weights were applied.

Next, weighted multivariable multinomial logistic regression was used to determine the predictors of tobacco use trajectories among a subsample of veterans—i.e., adult respondents who reported ever (but not currently) serving on active duty in the U.S. Armed Forces, Military Reserves or National Guard—who completed Waves 1 and 2 (n = 1902). The dependent variable was tobacco use transition category, as described above, and continued non-users served as the reference group. The independent variables of interest, which were entered simultaneously into the regression model, were sociodemographic characteristics, past year substance use, problematic drinking, self-reported physical health and self-reported mental health. In this analysis, Wave 2 survey weights, which adjusted for non-response in Wave 2, were applied. As instructed in the PATH user guide, Stata's "svy" command was used and the weights were specified to apply balanced repeated replications with Fay's adjustment set to 0.3. Missing data at the variable level ranged from 0.0% to 6.0%, therefore sample sizes for each model varied minimally. Stata 14.2 was used for all statistical analyses.

3. Results

3.1. Prevalence of tobacco use

Compared to non-veterans, past 30-day use of cigarettes, ENDS, cigarillos, traditional cigars, little filtered cigars, pipes, hookah, and snus was significantly higher among veterans, after estimates were adjusted at the means for age and sex. Among veterans, past 30-day use of any tobacco product was highest among those who served in the Marine Corps, followed by Army, Navy and Air Force. In terms of conflict served, past 30-day use of any tobacco product was highest among veterans who served since September 2001 or later (see Table 1). Estimates of past 30-day any tobacco use were significantly higher among veterans compared to non-veterans at ages 30, 40, 50, and 60 (see Fig. 1). Estimated probabilities of past 30-day any tobacco use were not significantly different between the two groups at ages 20, 70, 80 and 90.

3.2. Predictors of tobacco use transitions

As seen in Table 2., 66.0% of the analytic sample (i.e., veterans who completed both waves) were continued non-users, 26.9% were continued users, 3.8% were initiators, and 3.3% transitioned from any use to no use (i.e., cessation) between PATH Waves 1 and 2.

Results of the weighted multinomial logistic regression are presented in Table 3. Compared to continued non-users, continued users were more likely to: be of younger age (OR = 0.95, 95% CI: 0.95–0.96), have poorer physical health (OR = 1.58, 95% CI: 1.22–2.06) and mental health (OR = 1.48, 95% CI: 1.18–1.85), report other substance use in the past year (OR = 1.79, 95% CI: 1.21–2.64), and report problematic alcohol use (OR = 4.23, 95% CI: 2.38–7.52). Continued users were less likely be female (OR = 0.57, 95% CI: 0.35–0.93). Compared to continued non-users, initiators were more likely to report problematic alcohol use (OR = 8.63, 95% CI: 3.79–19.63). Compared to continued non-users, those in the cessation category were more likely to be of younger age (OR = 0.97, 95% CI: 0.95–0.99).

4. Discussion

In a longitudinal, population-representative sample, we found that

Table 1

Prevalence of past 30 day use of various tobacco products, Wave 1 (2013–2014), Population Assessment of Tobacco and Health, United States.

	Veterans (n = 2285; N = 19,940,041)		Non Veterans (n = 30,035; N = 216,751,544)		chi-square
	Weighted N	Weighted % (95% CI)	Weighted N	Weighted % (95% CI)	*p*-value
Tobacco Products[1]					
Cigarettes	4,185,694	23.49% (21.77–25.21%)	49,059,425	21.38% (20.70–22.07%)	0.03
ENDS	1,086,992	7.15% (6.27–8.03%)	14,647,095	5.52% (5.21–5.83%)	< 0.001
Cigarillos	618,004	3.32% (2.78–3.85%)	9,477,932	2.68% (2.47–2.88%)	0.01
Traditional Cigars	994,161	2.94% (2.53–3.35%)	7,288,115	2.19% (2.03–2.36%)	< 0.001
Little Filtered Cigars	395,866	2.06% (1.55–2.56%)	3,735,792	1.51% (1.33–1.68%)	0.02
Smokeless Tobacco	866,220	1.35% (1.07–1.64%)	6,184,455	1.15% (0.978–1.32%)	0.07
Pipe	337,516	0.95% (0.68–1.22%)	1,720,395	0.53% (0.45–0.60%)	< 0.001
Hookah	158,288	0.57% (0.35–0.80%)	5,029,723	0.38% (0.27–0.48%)	0.01
Snus	151,372	0.41% (0.25–0.56%)	1,291,058	0.20% (0.16–0.25%)	0.001
Dissolvable Tobacco	10,629	0.07% (0.02–0.16%)	226,617	0.08% (0.05–0.12%)	0.78
Branch of Service, Any Tobacco Use					
Marine Corps	910,013	41.82% (33.6–50.52%)	n/a	n/a	n/a
Army	3,005,606	32.37% (29.67–35.18%)	n/a	n/a	n/a
Navy	1,226,285	28.07% (24.14–32.36%)	n/a	n/a	n/a
Air Force	651,205	21.13% (17.18–25.72%)	n/a	n/a	n/a
Coast Guard	–	–	n/a	n/a	n/a
Conflict, Any Tobacco Use[2]					
September 2001 or later	1,380,316	47.74% (41.03–54.54%)	n/a	n/a	n/a
August 1990 to August 2001 (including Persian Gulf War)	1,114,218	32.39% (28.05–37.06%)	n/a	n/a	n/a
September 1980 to July 1990	1,279,938	34.94% (29.89–40.36%)	n/a	n/a	n/a
May 1975 to August 1980	821,107	31.95% (26.3–38.17%)	n/a	n/a	n/a
Vietnam era (August 1964 to April 1975)	1,735,168	25.9% (23.07–28.96%)	n/a	n/a	n/a
March 1961 to July 1964	364,040	22.14% (15.51–30.57%)	n/a	n/a	n/a
February 1961 or earlier	466,012	12.13% (9.35–15.58%)	n/a	n/a	n/a

*Notes:* Weighted N and percent were calculated using Wave 1 survey weights.

"CI" = Confidence Interval.

"n/a" = not applicable.

"—" = estimates not reported because unweighted population was smaller than threshold for disclosure.

[1] Estimates were calculated as adjusted predictions at the means for age and sex.

[2] "Any tobacco use" = use of at least one of the following products on 1 or more days in the past 30 days: cigarettes, ENDS, little filtered cigars, cigarillos, traditional cigars, smokeless tobacco, pipe, snus and dissolvable tobacco.
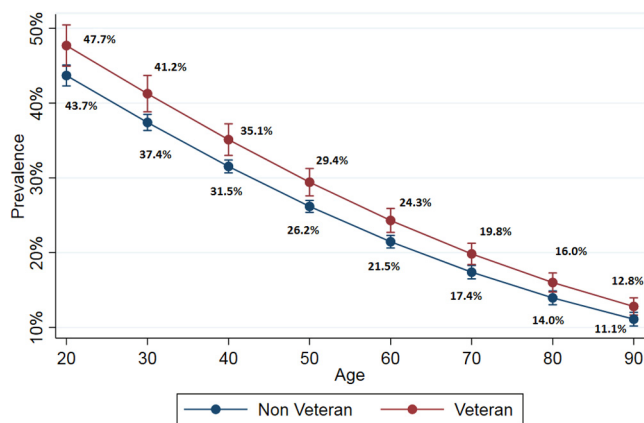
Fig. 1. Prevalence of past 30 day any tobacco use, veterans, and non-veterans, by age Wave 1 (2013–2014). Population Assessment of Tobacco and Health, United States.

veteran status continues to be a unique risk factor for tobacco use that is not satisfactorily accounted for by established risk factors such as sex and age. Tobacco use, including the use of cigarette and non-cigarette products, is prevalent in the U.S. veteran population, especially in younger veterans. This is consistent with the limited previous literature of non-cigarette use among veterans. For example, smokeless tobacco use was higher in veteran compared to non-veteran college students (Widome et al., 2011).

The current study found that nearly half (47.7%) of veterans who served during September 2001 or later reported past 30-day use of any tobacco product. Veterans who reported continued tobacco use over time had higher odds of comorbid conditions (poor physical health, poor mental health, other substance use and problematic alcohol use) compared to those who did not report continued use of tobacco products. This co-occurrence may indicate veterans are using tobacco and other substances to cope with physical and mental ailments. Veterans who initiated tobacco use between waves had higher odds of problematic alcohol use, which is supported by previous findings showing that alcohol and tobacco use reciprocally influence each other over time (Sher et al., 1996). Those who transitioned from any use to no use were more likely to be younger, compared to continued non-users, an unexpected finding given that previous literature documents higher successful quit attempts among older tobacco users (Levy et al., 2005). Our finding on age could be related to a third variable, such as nicotine dependence, which might be lower in younger users, but was not measured in this study.

In nearly all age groups, veterans had a higher prevalence of tobacco use than non-veterans. The exception was among 20 year olds, which could be attributed to several factors. First, 20 year old veterans with a shorter time in service (with its near ubiquitous tobacco presence) may not have been using tobacco products long enough to develop addiction. Second, high tobacco use rates are seen in the general population for this age group overall. These findings point to the need for early cessation efforts in both the military and general population. The 70–90 year old veteran group also did not differ from their non-veteran counterparts. Possible explanations include the fact that these individuals were in young adulthood during the release of the first Surgeon General report on smoking and health in 1964, perhaps contributing to their non-smoking status, or the reduced life expectancy associated with combustible tobacco use could have contributed to a lower number of tobacco users in the age group.

Our findings related to branch of service are consistent with previously-conducted studies on the topic (Barlas et al., 2011). Similar to a

Table 2

Descriptive statistics of analytic sample, veterans completing Wave 1 (2013–2014) and Wave 2 (2014–2015), Population Assessment of Tobacco and Health, (n = 1,902; N = 19,868,303), United States.

	Weighted N	Weighted %/Weighted Mean (95% CI)
Age		
Mean	19,863,419	60.08 (59.19–60.98)
Race/ethnicity		
White	15,914,598	81.33% (78.91–83.54)
Non-white	3,652,348	18.67% (16.46–21.09)
Gender		
Male	18,458,671	92.91% (91.42–94.15)
Female	1,409,632	7.10% (5.85–8.58)
Problematic Alcohol Use		
No	18,396,936	92.72% (91.36–93.88)
Yes	1,444,222	7.28% (6.12–8.64)
Past Year Substance Use		
No	16,327,674	85.51% (83.36–87.43)
Yes	2,766,376	14.49% (12.57–16.64)
PROMIS Physical Health[1]		
Mean	19,819,080	1.96 (1.92–2.00)
PROMIS Mental Health[2]		
Mean	19,802,743	2.12 (2.08–2.17)
Tobacco Use Transition Category[3]		
Continued Non-use	12,554,874	65.95% (63.53–68.29)
Continued Use	5,119,833	26.89% (25.00–28.87)
Initiation	726,875	3.82% (2.60–5.59)
Cessation	635,477	3.34% (2.65–4.20)

[1] The PROMIS Physical Health scale is a 4-item scale ranging from 1 (excellent) to 5 (poor).

[2] The PROMIS Mental Health scale is a 4-item scale ranging from 1 (excellent) to 5 (poor).

[3] Categories calculated from use (yes/no) of at least one of the following products on 1 or more days in the past 30 days: cigarettes, ENDS, little filtered cigars, cigarillos, traditional cigars, smokeless tobacco, pipe, snus and dissolvable tobacco.

Table 3

Weighted Multinomial Logistic Regression Model, Veterans Completing Wave 1 (2013–2014) and Wave 2 (2014–2015), (n = 1,707; N = 17,951,708), Population Assessment of Tobacco and Health, United States.

	Continued Use OR (95% CI)	Initiation OR (95% CI)	Cessation OR (95% CI)
Age	0.95*** (0.95–0.96)	0.98 (0.95–1.01)	0.97** (0.95–0.99)
Race/ethnicity (Non-white)	1.14 (0.81–1.62)	1.59 (0.63–3.98)	1.47 (0.82–2.63)
Gender (Female)	0.57* (0.35 - 0.93)	0.74 (0.20–2.67)	1.23 (0.55–2.76)
Problematic Alcohol Use	4.23*** (2.38–7.52)	8.63*** (3.79–19.63)	2.04 (0.66–6.34)
Past Year Substance Use	1.79** (1.21–2.64)	1.53 (0.45–5.17)	1.05 (0.52–2.15)
PROMIS Physical Health	1.58** (1.22–2.06)	1.42 (0.49–4.10)	1.36 (0.79–2.35)
PROMIS Mental Health	1.48** (1.18–1.85)	1.03 (0.51–2.09)	1.14 (0.73–1.81)

Notes: Continued non-users served as the reference group.

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

survey conducted in 2011 among active duty military, our study found tobacco use was highest among those who served in the Marines, followed by the Army, Navy and was lowest among Air Force veterans. Differences in prevalence between branches could be due to differences in military deployment and combat exposure, which have been found to be associated with smoking (Smith et al., 2008). Tobacco control policies also differ by branch of service; for example, the Air Force restricts tobacco companies from advertising in their military publications (Truth Initiative, 2018).

Tobacco use among veterans could be due to stress associated with re-integrating into civilian life. As such, the VA has a role in ensuring that smoking prevention and cessation resources are included during the transition to the VA's healthcare system. For example, multi-disciplinary team members who play a part in transitioning military members from active duty to enrollment in the VA healthcare system, should be equipped to provide referrals for smoking cessation services as well as introduce stress coping techniques to prevent tobacco and substance use. The U.S. veteran population has complex and substantial health needs—spanning conditions such as chronic disease as well as disability, injury, mental health and other health concerns, which are often linked to prior service in the military. Given these unique health needs, multifaceted cessation programs are an important component of a spectrum of treatments that many veterans will receive over their lifetime. Recognizing the complex interplay between tobacco use and other physical and mental comorbid conditions is important; as such, tobacco cessation programs for veterans should be tailored for this vulnerable population incorporating treatment for physical conditions, mental health conditions and substance use disorders. A recent review found that tobacco cessation is often not incorporated into clinical care for comorbid conditions, and treatment programs for mental health conditions or addiction are often not supportive of tobacco cessation, for example by allowing smoking to encourage social interaction or offering smoke breaks from therapy sessions (Rojewski et al., 2016). In populations with substance use disorders, combustible tobacco may be seen as the "safer" drug, but may in the long term be more deadly (Hurt et al., 1996).

Previous research shows there are significant challenges to implementing tobacco cessation and prevention programs during military service. First, the culture of tobacco use in the military represents a large hurdle for effective prevention. During World Wars I and II, members of the U.S. military received cigarettes as part of their rations (McKinney et al., 1997), which contributed to tobacco use's acceptability in military culture, including its high prevalence in combat arms like infantry and armor. While this was more than 60 years ago, pro-tobacco norms are still evident in today's military (Haddock et al., 2009). In fact, research on the efficacy of a smoking prevention program implemented among military personnel during basic training showed no impact on smoking initiation (Klesges et al., 2006). Other approaches that focus on cessation, like offering cessation after active duty or financial incentives (Naito and Higgins, 2012), may be more effective avenues to reduce tobacco use among this high risk population and warrant further exploration. Conversely, in order to reverse the deeply-entrenched pro-tobacco norms present in the military, more dramatic prevention efforts should be considered. For example, in 2009, the Institute of Medicine issued a call for a tobacco-free military to improve health outcomes and readiness among U.S. service members (Wedge and Bondurant, 2009). Ten years later, we have not seen this goal attained. While some progress has been made in implementing different tobacco control policies in the military, no branch is completely tobacco-free (Truth Initiative, 2018). Results from this paper highlight the need for continued discussion around tobacco control policies specifically for the military and veteran populations to achieve real progress in reducing tobacco use disparities among this vulnerable population which continues to use tobacco at rates higher than the general population.

Strengths and weaknesses should be considered when interpreting findings from this manuscript. Of particular strength is the robustness of the study's design and sample. The PATH study is a longitudinal, U.S.-representative sample; therefore findings are considered generalizable to the U.S. population. However, within the veteran sub-sample, two of the tobacco user trajectories (initiation and cessation categories) had a small sample size, which may have contributed to limited power to detect significant differences. In addition, the veterans were more likely than the overall population to be older and male, and while these differences were factored into the analysis approach, implications from

this research should be considered in this context.

Nevertheless, the current study paints a clear picture of cigarette and non-cigarette tobacco use as a sustained health threat to U.S. veterans, especially those who are of younger age. Veterans who are continued users of tobacco have higher odds of other comorbid conditions, which should be taken into account when considering tobacco treatment options.

Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

Barlas, F.M., Higgins, W.B., Pflieger, J.C., Diecker, K., 2011. Health Related Behaviors Survey of Active Duty Military Personnel. Fairfax, VA.

Beckham, J.C., Roodman, A.A., Shipley, R.H., et al., 1995. Smoking in Vietnam combat veterans with post-traumatic stress disorder. J. Traum. Stress 8 (3), 461–472.

Beckham, J.C., Kirby, A.C., Feldman, M.E., et al., 1997. Prevalence and correlates of heavy smoking in Vietnam veterans with chronic posttraumatic stress disorder. Addict. Behav. 22 (5), 637–647.

Brown, D.W., 2010. Smoking prevalence among US veterans. J. Gen. Intern. Med. 25 (2), 147–149.

Chapman, S.L., Wu, L.T., 2015. Associations between cigarette smoking and pain among veterans. Epidemiol. Rev. 37, 86–102.

Gierisch, J.M., Straits-Tröster, K., Calhoun, P.S., Acheson, S., Hamlett-Berry, K., Beckham, J.C., 2012. Tobacco use among Iraq- and Afghanistan-era veterans: a qualitative study of barriers, facilitators, and treatment preferences. Prev. Chron. Dis.

Green, K.J., Hunter, C.M., Bray, R.M., Pemberton, M., Williams, J., 2008. Peer and role model influences for cigarette smoking in a young adult military population. Nicot. Tob. Res. 10 (10), 1533–1541.

Haddock, C.K., Taylor, J.E., Hoffman, K.M., et al., 2009. Factors which influence tobacco use among junior enlisted personnel in the United States Army and Air Force: a formative research study. Am. J. Health Prom. 23 (4), 241–246.

Hays, R.D., Bjorner, J.B., Revicki, D.A., Spritzer, K.L., Cella, D., 2009. Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. Qual. Life Res. 18 (7), 873–880.

Hefner, K., Rosenheck, R., Merrel, J., Coffman, M., Valentine, G., Sofuoglu, M., 2016. E-cigarette use in veterans seeking mental health and/or substance use services. J. Dual Diagn. 12 (2), 109–117.

Helmer, D.A., Chandler, H.K., Quigley, K.S., Blatt, M., Teichman, R., Lange, G., 2009. Chronic widespread pain, mental health, and physical role function in OEF/OIF veterans. Pain Med. 10 (7), 1174–1182.

Hurt, R.D., Offord, K.P., Croghan, I.T., et al., 1996. Mortality following inpatient addictions treatment: role of tobacco use in a community-based cohort. JAMA 275 (14), 1097–1103.

Klesges, R.C., DeBon, M., Vander Weg, M.W., et al., 2006. Efficacy of a tailored tobacco control program on long-term use in a population of US military troops. J. Consult. Clin. Psychol. 74 (2), 295.

Levy, D.T., Romano, E., Mumford, E., 2005. The relationship of smoking cessation to sociodemographic characteristics, smoking intensity, and tobacco control policies. Nicot. Tob. Res. 7 (3), 387–396.

Linde, B.D., Ebbert, J.O., Pasker, C.K., et al., 2015. Prevalence and predictors of hookah use in US Air Force military recruits. Addict. Behav. 47, 5–10.

Little, M.A., Derefinko, K.J., Colvin, L., et al., 2015. The prevalence of E-cigarette use in a sample of U.S. Air Force recruits. Am. J. Prev. Med. 49 (3), 402–408.

Little, M.A., Derefinko, K.J., Bursac, Z., et al., 2016. Prevalence and correlates of tobacco and nicotine containing product use in a sample of United States Air Force trainees. Nicot. Tob. Res. 18 (4), 416–423.

Malte, C.A., Dennis, P.A., Saxon, A.J., et al., 2015. Tobacco use trajectories among a large cohort of treated smokers with posttraumatic stress disorder. Addict. Behav. 41, 238–246.

McFall, M., Saxon, A.J., Thompson, C.E., et al., 2005. Improving the rates of quitting smoking for veterans with posttraumatic stress disorder. Am. J. Psychiatr. 162 (7), 1311–1319.

McKinney, W.P., McIntire, D.D., Carmody, T.J., Joseph, A., 1997. Comparing the smoking behavior of veterans and nonveterans. Pub. Health Rep. 112 (3), 212.

Naito, N.A., Higgins, S.T., 2012. Controlling health care costs in the military: the case for using financial incentives to improve beneficiary personal health indicators. Prevent. Med. 55, S113–S115.

National Institute on Alcohol Abuse and Alcoholism, 2019. Drinking Levels Defined. https://www.niaaa.nih.gov/alcohol-health/overview-alcohol-consumption/moderate-binge-drinking.

Rojewski, A.M., Baldassarri, S., Cooperman, N.A., Gritz, E.R., Leone, F.T., 2016. Exploring issues of comorbid conditions in people who smoke. Nicot. Tob. Res. 18 (8), 1684–1696.

Sher, K.J., Gotham, H.J., Erickson, D.J., Wood, P.K., 1996. A prospective, high-risk study of the relationship between tobacco dependence and alcohol use disorders. Alcohol. Clin. Exp. Res. 20 (3), 485–492.

Smith, B., Ryan, M.A., Wingard, D.L., et al., 2008. Cigarette smoking and military deployment: a prospective evaluation. Am. J. Prevent. Med. 35 (6), 539–546.

Talcott, G.W., Cigrang, J., Sherrill-Mittleman, D., et al., 2013. Tobacco use during military deployment. Nicot. Tob. Res. 15 (8), 1348–1354.

Truth Initiative, 2018. Tobacco Use in the Military. https://truthinitiative.org/news/tobacco-use-military.

US Department of Health and Human Services, 2014. The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, Atlanta, GA, p. 17.

US Department of Health and Human Services, 2017. National Institutes of Health, National Institute on Drug Abuse, Food and Drug Administration, Center for Tobacco Products. Population Assessment of Tobacco and Health (PATH) Study [United States] Restricted-Use Files. ICPSR36231-v13. Inter-university Consortium for Political and Social Research, Ann Arbor, MI ([distributor]2017-06-19).

US Department of Veterans Affairs, 2017. National Center for Veterans Analysis and Statistics. Expenditure Tables: Medical Costs, FY2017. https://www.va.gov/vetdata/Expenditures.asp (access date November 30, 2018).

Vander Weg, M.W., Peterson, A.L., Ebbert, J.O., Debon, M., Klesges, R.C., Haddock, C.K., 2008. Prevalence of alternative forms of tobacco use in a population of young adult military recruits. Addict. Behav. 33 (1), 69–82.

Wedge, R., Bondurant, S., 2009. Combating Tobacco Use in Military and Veteran Populations. National Academies Press.

Widome, R., Laska, M.N., Gulden, A., Fu, S.S., Lust, K., 2011. Health risk behaviors of Afghanistan and Iraq war veterans attending college. Am. J. Health Promot. 26 (2), 101–108.

Williams, R., 2012. Using the margins command to estimate and interpret adjusted predictions and marginal effects. Stata J. 12 (2), 308.

Yoon, J., Zulman, D., Scott, J.Y., Maciejewski, M.L., 2014. Costs associated with multimorbidity among VA patients. Med. Care 52, S31–S36.