



## Influence of gender on initiation of tobacco and nicotine containing product use among U.S. Air Force trainees

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### ABSTRACT

Military personnel are a subgroup of young adults at risk for tobacco and nicotine containing product (TNCP) use. This study of US Air Force (USAF) trainees who were never users of TNCPs examined gender, peer tobacco use, and tobacco use intentions as predictors of TNCP initiation after Basic Military Training (BMT). We used a longitudinal cohort assessment study design with baseline and 1-year surveys completed (2011–2016) among 2393 USAF trainees: 73% men, 95% aged 18–25 years, 36% racial minorities. Overall, initiation of any TNCP use at 1-year was 23% (20% women, 24% men). From a multivariable multinomial logistic regression model predicting TNCP use at 1-year follow-up, significant 2-way interactions were detected between gender and number of close friends using tobacco before BMT ( $p = 0.015$ ), and between gender and tobacco use intentions ( $p < 0.0001$ ). Women reporting almost all or many close friends used tobacco were more likely to report TNCP use compared to women with none (Odds ratio [OR] = 5.8, 95% CI 2.5–13.5, Bonferroni corrected  $p < 0.0001$ ). Having close friends using tobacco had little influence on TNCP use among men. Men with tobacco use intentions were more likely to report TNCP use compared to men having no intentions (OR = 8.0, 95% CI: 4.7–13.6, Bonferroni corrected  $p < 0.001$ ), but tobacco use intentions had little influence among women. In this sample of USAF trainees, the study provides novel prospective findings on TNCP initiation, and how men and women are influenced differently by peer tobacco use and tobacco use intentions. Gender-specific prevention efforts focused on uptake of TNCPs appear warranted.

### 1. Introduction

Tobacco use remains the leading cause of preventable death in the US (U.S. Department of Health and Human Services, 2014). Use of tobacco and associated disease burden is increasingly concentrated among vulnerable and frequently overlapping disparity populations (Drope et al., 2018; Jha et al., 2013). In particular, recent attention has focused on young adulthood as a distinct developmental period with heightened vulnerability to initiation of tobacco and nicotine containing product (TNCP) use (Cantrell et al., 2018; Foldes et al., 2010; Fuemmeler et al., 2013; Hammond, 2005; Rath et al., 2012; Richardson et al., 2014; Soneji et al., 2016; Terry-McElrath and O'Malley, 2015; Thompson et al., 2015, 2017). Military personnel are a subgroup of young adults with greater prevalence of TNCP use (Drope et al., 2018). There is limited *prospective* research among *never users* that examined

TNCP initiation after Basic Military Training (BMT). Among large samples of US Air Force (USAF) trainees (largely a racially/ethnically diverse, non-college attending young adult population, with average age of 20.5 years), between 8 and 11% of never smokers were found to initiate cigarette smoking within the first year after BMT (Klesges et al., 1999; Klesges et al., 2010; Little et al., 2019); initiation of smokeless tobacco (ST) was 7.9% (Dunkle et al., 2019). However, prior studies did not assess contemporary products (e.g., Hookah and e-cigarette use).

Factors associated with increased likelihood of cigarette smoking or ST use initiation among USAF trainees included male gender and identifying as other race or more than 1 race (Dunkle et al., 2019; Little et al., 2019). Social-environmental influences, including peer tobacco use, have been associated with trajectories of cigarette smoking initiation and escalation among young adults generally (Foldes et al., 2010; Fuemmeler et al., 2013; Gray et al., 2016; Johnson et al., 2019;

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Klein et al., 2013), as well as initiation of cigarette smoking among USAF trainees (Green et al., 2008; Little et al., 2019). Intentions or susceptibility to use tobacco are robust proximal predictors of future tobacco use in representative young adult samples (Choi et al., 2001; Pierce et al., 1996; Stewart and Moreno, 2013; Wakefield et al., 2004; Warren et al., 2006). Among USAF trainees, however, tobacco use intentions were not associated with initiation of cigarette smoking (Little et al., 2019) or ST use (Dunkle et al., 2019) in the year following BMT.

In a recent report (Patten et al., 2019), we examined predictors of intentions to use tobacco after BMT among USAF trainees. We found that prior tobacco use was associated with increased likelihood of tobacco use intentions. In addition, gender moderated effects of peer tobacco use on tobacco use intentions such that women were influenced more by friends who smoked cigarettes and men by peers who used ST. Interesting, among the sub-group of never tobacco users, women reported higher tobacco use intentions than men. Building on this previous work, the current study of USAF trainees assessed initiation of TNCP use 1 year after BMT among those reporting at baseline that they had never used TNCPs. We extended prior research by examining interactions of gender and peer tobacco use and tobacco use intentions on initiation of TNCPs, and by assessing a broader range of products. Based on an integrative model (Fishbein and Yzer, 2003) from social cognitive theory (Cohen, 2004) and theory of reasoned action (Fishbein and Ajzen, 1975), and drawing from research findings described above, we hypothesized that women would be influenced to use TNCPs more by peer use of tobacco and tobacco use intentions on initiation as compared with men.

## 2. Methods

### 2.1. Study design

Longitudinal cohort assessment study with baseline and 1-year follow-up surveys.

### 2.2. Participants and procedures

The study was approved by the 59th Medical Wing's Department of Defense (DoD), and the University of Virginia, Charlottesville, Institutional Review Boards. Data collection occurred between 2011 and 2016.

Airmen complete 8.5 weeks of BMT during which time TNCP use is prohibited. After graduation, Airmen enter Technical Training where they acquire advanced skills and are required to remain abstinent from TNCPs for the first four weeks. Study enrollment and the baseline survey were completed during the beginning of the four-week Technical Training abstinence period. At baseline, questions addressed ever use of TNCPs, before starting BMT.

Participants were US Airmen receiving training at 1 of 4 Technical Training Bases (Lackland and Ft. Sam in San Antonio, TX; Keesler in Gulfport MS; and Sheppard in Wichita Falls, TX) between March 2011 and March 2015. Fig. 1 shows the study flow. During week one of Technical Training, 27,544 Airmen were convened by squadron in groups of about 50, and were provided a description of the study which was to evaluate tobacco initiation and re-initiation among military personnel. After the opportunity to ask and have questions answered, informed consent and HIPAA forms were signed by participants in accordance with 59th Medical Wing Institutional Review Boards requirements. A total of 78.6% of Airmen consented to participate and complete the baseline questionnaire ( $N = 21,650$ ).

A 1-year follow-up survey was conducted only among active duty Airmen. Three months before the 1-year follow-up window opening, 2226 non-active duty Airmen (i.e., National Guard [ $n = 1046$ ] or Reserve [ $n = 1180$ ]) were identified. Of the remaining 19,424 Active Duty Airmen, we estimated that 25% were ineligible due to being overseas, separated, or incarcerated; and that an additional 15% would

be ineligible or terminated due to other reasons, e.g., deceased, deployed, switched service branches). Thus, we oversampled in our stratified random sampling procedure to achieve a 25% follow-up rate. Airmen were stratified by Air Force Base.

Among the 19,424 (89.7%) participants eligible for the 1-year follow-up, 8022 (41.3%) were randomly selected. A list of these participants was sent to the Defense Manpower Data Center (DMDC) to obtain participants' contact information. The DMDC maintains the largest archive of personnel, manpower, training, and financial data in the DoD. Of these 8022, 1380 were either ineligible ( $n = 995$ , 12.4%), or terminated ( $n = 365$ , 4.5%) or voluntarily withdrew ( $n = 20$ , 0.2%) from the study.

Eligible participants ( $n = 6642$ ) were contacted by phone to complete the 1-year follow up, of which the assessment was completed by  $N = 4596$  (69.2%) Airmen. Of these, 2393 reported on the baseline questionnaire never use of TNCPs and form the basis of this report. At 1-year follow-up, 1283 of these participants answered not using any TNCPs (Nonuse: reference outcome category). However, an additional 566 participants responded not using some of the TNCPs, but missed answering for the other products. These individuals were classified as "Other" 1-year outcome category.

### 2.3. Measures

Participants completed surveys at 2 time points, at baseline and at 1-year follow-up.

#### 2.3.1. Demographics

Characteristics assessed on the baseline survey were gender (men, women), age (continuous), marital status (single/separated/divorced, married/living as married), education (high school diploma/GED, some education beyond high school, 4-year degree or more), race (White, Black/African American, Asian, more than 1 race, other), and Hispanic ethnicity (yes, no).

#### 2.3.2. Peer tobacco use

On the baseline survey, participants were asked about their friends' use of tobacco prior to BMT. There were 2 different versions of the baseline survey administered in this military cohort that asked about peer use of tobacco differently. In version 1, participants were asked 3 questions to assess use prior to BMT, how many of their closest friends smoked cigarettes, used ST, or both, respectively. In version 2, participants were asked only 1 question to assess how many of their closest friends smoked cigarettes or used some other form of tobacco before BMT. Response options for items were identical across the 2 baseline surveys: almost all (80% or more), many (50%–79%), some (20%–49%), few (less than 20%), or none. Variables were collapsed across the 2 surveys to indicate, prior to BMT, how many of the participant's closest friends smoked cigarettes or used some other form of tobacco, with the same response options as above.

#### 2.3.3. Tobacco use intentions

On the baseline questionnaire, participants were asked "Once you complete Technical Training, which of these best describes you?" with response options: "I plan to remain tobacco-free," "I am thinking about using tobacco products," or "I will definitely use tobacco products." Those indicating they planned to remain tobacco-free were classified as no tobacco use intentions. Consistent with prior studies (Dube et al., 2013; Gregoire et al., 2016; Ladapo et al., 2014; Ling et al., 2007), participants indicating they were thinking about or definitely planning to use tobacco were classified as tobacco use intentions.

#### 2.3.4. TNCP use

At baseline, all participants were in the first week of Technical training and required to be tobacco-free. Therefore, questions addressed ever (lifetime) use of TNCPs before starting BMT. The

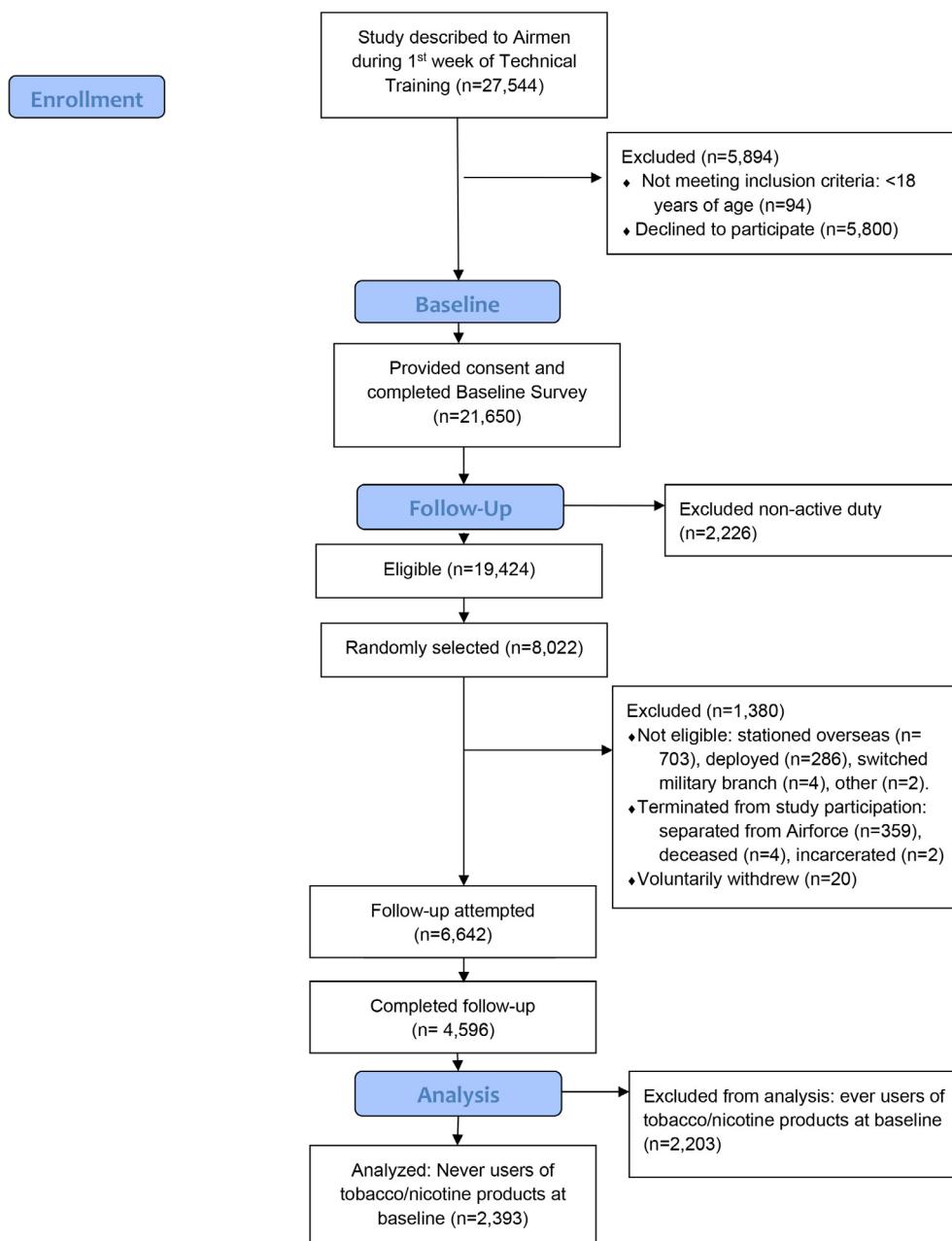


Fig. 1. Study Flow.

questionnaire assessed ever use of the following TNCPs: cigarettes, roll your own cigarettes, cigarillos, cigars, pipe, ST use (chew, snuff, snus, dissolvables), Hookah use, and electronic cigarettes/vape. Participants reporting never use of any these TNCPs at baseline were classified as never users (Klesges et al., 2011).

The 1-year follow-up questionnaire assessed any use of the same TNCPs over the past 12-month period. At 1-year follow-up, participants were classified as: 1) Non-users: reported none of these TNCPs in the past 12 months; 2) Seldom TNCP users: reported use of any of these TNCPs in the past 12 months but use was less than once per month; 3) Regular TNCP users: used any of these TNCPs in the past 12 months and used at least once per month; or 4) Other: reported no use of some of these TNCPs, but missed reporting for other products.

#### 2.4. Statistical analyses

All eligible randomly selected Airmen who completed the follow-up

survey and reported never use of TNCPs at baseline were included in the final analysis (see Fig. 1). Our primary analytic approach was to use a multinomial logistic regression model to assess how gender and social-environmental factors (peer tobacco use and tobacco use intentions) influenced use of TNCPs at 1-year follow-up. Specifically, we assessed main effects of participants' gender and social-environmental factors (peer tobacco use and tobacco use intentions), as well as potential interaction effects between participants' gender and social-environmental factors, on use of TNCPs at 1-year follow-up. The model was also adjusted for other participant demographic characteristics (i.e., age, race, ethnicity, education, and marital status). Because eligible Airmen were randomly selected within each squadron across bases, the model was also adjusted for the sample design which included both stratification and clustering where the strata were the bases and the clusters were squadrons, and the sampling weights due to different selection probabilities for the different bases. Taylor series variance estimation method was used for adjusting for the variance of the

fit to correct for correlations between Airmen within each squadron. Because we were interested in the subsample of Airmen who never used any TNCPs at baseline, a domain analysis of the multinomial logistic regression model was employed to incorporate the variability of the formation of different domains of use of any TNCPs at baseline into the variance estimation. The overall ability of the multinomial logistic regression model to discriminate between the 4 TNCP use categories was quantified by estimating nonparametric polytomous discrimination index and bootstrapped 95% confidence interval (Li et al., 2018; Van Calster et al., 2012), and pairwise C-statistics (Hand and Till, 2001) between each categories can be calculated to find out which categories can be well discriminated. To control type I error rate due to multiple comparisons, Bonferroni multiple comparisons adjustment was used for comparisons of primary interests. The significance level was specified at 0.05. All analyses were performed in SASv9.4 (Cary, NC, USA) and R3.6.0 (The R Foundation for Statistical Computing).

### 3. Results

#### 3.1. Participants

Table 1 presents baseline demographic characteristics by TNCP use at 1-year follow-up among never users at baseline. Participants ( $N = 2393$ ) were primarily men (73%) with a mean age of 20.5 (SD = 2.4) (range 18–36) years and 95% were aged 18–25 years. Overall, 88% were single, 48% reported education beyond high school, 36% were racial minorities, and 16% were of Hispanic ethnicity. At baseline, 31% reported that prior to BMT none of their close friends used tobacco, and 95% reported no intentions to use tobacco after Technical Training.

#### 3.2. Tobacco and nicotine containing product use at 1-year follow-up

At 1-year follow-up, 1283 (53.6%) remained non-users of TNCPs, 240 (10.0%) reported regular use of any TNCP, 304 (12.7%) reported seldom use of any TNCP, and 566 (23.7%) were categorized as Other (Table 1). Thus, overall 22.7% of this sample of never users at baseline initiated any TNCP use at 1-year follow-up (20.0% among women, 23.7% among men). There were significant associations between TNCP use at the 1-year follow-up, and gender ( $p = 0.0003$ , see Table 1), and number of friends who use tobacco ( $p < 0.0001$ ), and intent to use tobacco ( $p < 0.0001$ ).

#### 3.3. Multivariable predictors of tobacco and nicotine containing product use at 1-year follow-up

From the final multivariable multinomial logistic regression model, there were significant gender and number of close friends who use tobacco main effects ( $p < 0.0001$ , respectively) though intention to use tobacco main effects was not ( $p = 0.207$ ), and 2-way interaction effects between gender and number of close friends who use tobacco ( $p = 0.015$ ), and between gender and intention to use tobacco ( $p < 0.0001$ ).

##### 3.3.1. Primary comparison of TNCP use (regular use vs. nonuse)

Overall, men were more likely to report regular TNCP use at 1-year follow-up than women (OR = 6.5, 95% CI 2.0–20.4,  $p = 0.015$ ). Compared with participants reporting none of close friends used tobacco, those reporting almost all or many close friends used tobacco were more likely to report regular TNCP use at 1-year follow-up (OR = 2.8, 95% CI 1.6–4.7, Bonferroni corrected  $p = 0.001$ ), and those reporting some or few friends used tobacco were also more likely to report regular TNCP use as well (OR = 1.8, 95% CI 1.2–2.5, Bonferroni corrected  $p = 0.003$ ). Participants with tobacco use intentions were no different in reporting regular TNCP use than those without tobacco use intentions (OR = 1.4, 95% CI 0.5–3.9,  $p = 0.578$ ). However, significant 2-

way interactions effects was detected between gender and number of close friends used tobacco on regular TNCP use at 1-year follow-up ( $p = 0.015$ ), indicating that women and men were influenced differently by number of close friends who used tobacco. Among women, those reporting almost all or many close friends used tobacco were almost 6 times as likely to report regular TNCP use compared to those with none (OR = 5.8, 95% CI 2.5–13.5, Bonferroni corrected  $p < 0.0001$ , see Table 2). Women with some or few close friends used tobacco were more than twice as likely compared to women with none to report regular TNCP use (OR = 2.4, 95% CI 1.4–3.9, Bonferroni corrected  $p = 0.003$ ). In contrast, having close friends who used tobacco seemed to have no or little influence on predicting regular TNCP use among men. There were no significant differences in predicting regular TNCP use among men when comparing those with few, some, many, or almost all with no close friends who used tobacco. And, from Table 2, women as compared to men, among those with no close friends used tobacco prior to BMT, appeared to be protective for initiating regular use of TNCPs (OR = 12.8, 95% CI 3.7–44.2, Bonferroni corrected  $p < 0.0001$ ). Men, among some or few peers used tobacco, were 7 times as likely to initiate regular TNCP use compared with women; (OR = 7.1, 95% CI: 2.0–25.3, Bonferroni corrected  $p = 0.01$ ).

And, significant 2-way interactions effects was also detected between gender and tobacco use intentions ( $p < 0.0001$ ), with tobacco use intentions appearing to influence men more than women in predicting initiation of regular TNCP use (Table 2). Among those with tobacco use intentions, men were more likely to report regular TNCP use compared with women (OR = 38.3, 95% CI 4.3–341.0, Bonferroni  $p = 0.002$ ). For men, the odds of regular TNCP use for those with tobacco use intentions was 8 times greater compared to those with no tobacco use intentions (OR = 8.0, 95% CI 4.7–13.6, Bonferroni corrected  $p < 0.0001$ ). In contrast, among women, there was no significant difference between those with and without tobacco use intentions.

##### 3.3.2. Secondary comparison of TNCP use (seldom use vs. nonuse)

As with regular TNCP use, men with tobacco use intentions were more than 3 times as likely to initiate seldom use of TNCPs compared with those who reported no tobacco use intentions (OR = 3.2, 95% CI 1.8–5.8, Bonferroni corrected  $p < 0.0001$ ). In contrast, tobacco use intentions appeared to have no or little influence in predicting seldom use of TNCPs among women at 1-year follow-up (Table 2).

Because our outcome has 4 categories (nonuse, regular TNCP use, seldom TNCP use, and other), the null polytomous discrimination index (PDI) of the overall model is  $\frac{1}{4} = 0.25$  (viz., random guess). The estimated PDI of 0.37 (bootstrapped 95% confidence interval: 0.36–0.38) from our overall model is about 1.5 times of the lower bound which corresponds to no discriminative ability, indicating that our overall model has moderately good predictive discriminative ability. The pairwise C-statistics of 0.72 for the comparison of “regular TNCP use” and “Nonuse” categories at 1-year follow-up indicated that our model has good discriminative ability for the comparison of the primary interests.

### 4. Discussion

This study of USAF trainees, who at the start of BMT reported never use of TNCPs, observed the rate of initiation of use 1 year following BMT to be 23% (20% women, 24% men). This was despite the fact that at baseline, 95% of the sample reported no tobacco use intentions after Technical Training. Our rate of initiation is much higher than previously reported among USAF trainees, but past studies were limited to initiation of cigarette smoking (Klesges et al., 1999; Klesges et al., 2010; Little et al., 2019) and ST products (Dunkle et al., 2019), respectively. For example, (Klesges et al., 2010) found that at 1-year follow-up, 13% of USAF trainees initiated tobacco (cigarette smoking, ST use, or both). The Millennium Cohort Study found that smoking initiation during

**Table 1**  
Descriptive statistics of Air Force Trainees' demographic and baseline information by any tobacco and nicotine containing product use at 1-year follow-up among never users at baseline (N = 2393).

Variable at Baseline	Tobacco and Nicotine Containing Product Use at 1-Year Follow-up				P-value
	Nonuse (n = 1,283)	Regular Use of Any Products (n = 240)	Seldom Use of Any Products (n = 304)	Other (n = 566)	
Age (n = 2393)	20.7 (19.0, 20.0, 22.0)	19.8 (18.0, 19.0, 21.0)	20.2 (19.0, 20.0, 22.0)	20.7 (19.0, 20.0, 22.0)	< 0.0001
Gender (n = 2392):					0.0003
Men	955 (74.49%)	200 (83.33%)	217 (71.38%)	386 (68.20%)	
Women	327 (25.51%)	40 (16.67%)	87 (28.62%)	180 (31.80%)	
Race (n = 2393):					< 0.0001
White	845 (65.86%)	160 (66.67%)	177 (58.22%)	359 (63.43%)	
Black/African American	225 (17.54%)	38 (15.83%)	54 (17.76%)	102 (18.02%)	
Asian	52 (4.05%)	7 (2.92%)	14 (4.61%)	29 (5.12%)	
More Than One Race	82 (6.39%)	15 (6.25%)	26 (8.55%)	40 (7.07%)	
Other Race	79 (6.16%)	20 (8.33%)	33 (10.86%)	36 (6.36%)	
Hispanic (n = 2364):					< 0.0001
Yes	182 (14.38%)	38 (16.17%)	69 (22.85%)	91 (16.22%)	
No	1,084 (85.62%)	197 (83.83%)	233 (77.15%)	470 (83.78%)	
Education (n = 2383):					< 0.0001
Bachelor's Degree or Higher	82 (6.42%)	14 (5.83%)	21 (6.95%)	44 (7.80%)	
High School Graduate/GED	661 (51.76%)	155 (64.58%)	179 (59.27%)	253 (44.86%)	
Some Education after High School	534 (41.82%)	71 (29.58%)	102 (33.77%)	267 (47.34%)	
Marital Status (n = 2391):					< 0.0001
Married/Living as Married	191 (14.91%)	21 (8.75%)	21 (6.91%)	59 (10.42%)	
Single/Separated/Divorced	1,090 (85.09%)	219 (91.25%)	283 (93.09%)	507 (89.58%)	
Prior to BMT, how many of your closest friends smoked cigarettes or used some other form of tobacco (n = 2393):					< 0.0001
Almost all	40 (3.12%)	13 (5.42%)	11 (3.62%)	12 (2.12%)	
Many	132 (10.29%)	36 (15.00%)	34 (11.18%)	31 (5.48%)	
Some	218 (16.99%)	56 (23.33%)	64 (21.05%)	85 (15.02%)	
Few	473 (36.87%)	85 (35.42%)	89 (29.28%)	190 (33.57%)	
None	420 (32.74%)	50 (20.83%)	106 (34.87%)	248 (43.82%)	
Once you complete Technical Training, which of these best describes you (n = 2390):					< 0.0001
Plan to remain tobacco free	1,240 (96.72%)	196 (82.01%)	278 (91.75%)	548 (96.82%)	
Thinking about using tobacco products	19 (1.48%)	16 (6.69%)	12 (3.96%)	3 (0.53%)	
Will definitely use tobacco products	23 (1.79%)	27 (11.30%)	13 (4.29%)	15 (2.65%)	

Note: Continuous variable displayed as mean (1st quartile, median, 3rd quartile).

Regular Use: at least monthly use; Seldom Use: less than monthly use; Other: answer 'Never' to some of tobacco products use and miss information on answering to the other tobacco products use; Never Use/Nonuse: Never/No use of any tobacco products.

P-value was estimated from univariate multinomial logistic regression analyses which also adjusted for the complex sample design including stratification and clustering and sampling weights.

BMT = Basic Military Training.

military service among 2 older and younger cohorts who had never smoked ranged was 6.1% and 6.8% respectively (Boyko et al., 2015). Our findings are innovative and extend the literature by examining the potential moderating role of gender and peer tobacco use, and tobacco use intentions, on TNCP use initiation. Key findings were that women

were influenced more than men by peer use of tobacco before BMT, with fewer peers who used tobacco appearing to have a protective effect on initiation among women. In contrast, men were more influenced by tobacco use intentions as compared with women. Our prior report indicated that women who were never users had increased likelihood of

**Table 2**

Interaction effects between gender and peer influence and between gender and tobacco use intentions in predicting probability of any tobacco and nicotine containing product use at 1-year follow-up among never users at baseline.

Variable at Baseline	Regular Use of Any Product vs. Nonuse			Seldom Use of Any Product vs. Nonuse		
	Odds Ratio	95% CI	P-value	Odds Ratio	95% CI	P-value
Women & number of close friends who smoke cigarettes or use some other form of tobacco:						
Almost All/Many vs. None	5.76	2.45–13.54	< 0.0001	1.06	0.42–2.66	0.905
Some/Few vs. None	2.37	1.42–3.94	0.001	1.17	0.66–2.09	0.594
Almost All/Many vs. Some/Few	2.43	1.18–5.02	0.016	0.90	0.35–2.37	0.837
Men & number of close friends who smoke cigarettes or use some other form of tobacco:						
Almost All/Many vs. None	1.33	0.90–1.98	0.152	1.03	0.70–1.53	0.870
Some/Few vs. None	1.31	0.89–1.93	0.176	0.77	0.52–1.13	0.185
Almost All/Many vs. Some/Few	1.02	0.61–1.69	0.943	1.34	0.84–2.13	0.215
Number of close friends who smoke cigarettes or use some other form of tobacco:						
Among Almost All/Many: Men vs. Women	2.97	0.91–9.67	0.071	2.44	0.99–6.05	0.053
Among Some/Few: Men vs. Women	7.09	1.98–25.33	0.003	1.65	0.46–5.86	0.441
Among None: Men vs. Women	12.82	3.72–44.20	< 0.0001	2.50	0.75–8.37	0.137
Women & Intentions to use any tobacco products: Yes vs. No	0.23	0.03–1.79	0.160	0.56	0.09–3.59	0.540
Men & Intentions to use any tobacco products: Yes vs. No	8.01	4.73–13.59	< 0.0001	3.23	1.81–5.75	< 0.0001
Intentions to use any tobacco products: Men vs. Women	38.30	4.30–340.97	0.001	5.19	0.69–39.18	0.110
No-intentions to use any tobacco products: Men vs. Women	1.09	0.74–1.61	0.663	0.90	0.65–1.24	0.518

Note: The multinomial logistic regression model was also adjusted for age, race/ethnicity, education, and marital status.

Regular Use: at least monthly use; Seldom Use: less than monthly use; Other: answer 'Never' to some of tobacco/nicotine product use and missing information on answering to the other product use; Never Use/Nonuse: Never/No use of any tobacco/nicotine product.

tobacco use intentions as compared with men (Patten et al., 2019), but unexpectedly, in the current study, tobacco use intentions did not appear to influence females on actual uptake of use of TNCPs during a 1-year time period.

Our results have implications for tobacco control interventions in the military targeting prevention of tobacco and nicotine product use uptake after Technical Training. Brief behavioral intervention efforts among USAF trainees were effective for reducing current cigarette smoking (Klesges et al., 1999) but had limited success on initiation (Klesges et al., 2006). In particular, new types of interventions may be needed to address these “late starters.” Reducing social smoking may be a key target for intervention efforts for women USAF trainees. For example, consistent with social learning theory, one strategy could be to develop a social media-based platform for women to reinforce connections with, and social support from, non-using peers (Graham et al., 2019; Kim et al., 2017; Villanti et al., 2019). Initiation of TNCP use is increasingly becoming more concentrated in young adulthood (Thorndike, 2019; Villanti et al., 2019). As the nation’s largest employer, the military provides an opportune platform for prevention efforts among young adults (Chang, 2015). The potential public health impact of effective prevention interventions for this tobacco-use disparity group is considerable.

#### 4.1. Strengths and limitations

This study has several strengths including the longitudinal data and assessment of use of several contemporary TNCPs. Our final multivariable model had good predictive discrimination power for the primary comparison of TNCP use. Moreover, the sample comprised non-college attending young and middle-aged adults, primarily between the ages of 18 and 25 (95%).

Some study limitations need to be considered when interpreting the results. The number of subjects included in the tests for interaction effects are small with large confidence intervals. We assessed peer tobacco use before BMT, and did not collect information on current social influences, including military friends. Future studies should measure the extent that current peer selection and influence has on TNCP use initiation among military personnel. Body Mass Index (BMI) was not included, as this variable was only measured in 1 of the surveys ( $n = 1160$  of 2393) from which these data were analyzed. However,

prior 1-year follow-up studies of USAF trainees after BMT found no association of BMI with initiation of ST use (Dunkle et al., 2019) or with cigarette smoking (Little et al., 2019). Collapsing of the 2 versions of the survey for peer use of tobacco is also a limitation. Version 1 of the survey did not capture friends who used tobacco products other than ST or cigarettes. Thus, that survey may underestimate peer tobacco use. We surveyed individuals of only 1 service branch in the US military. However, after the Army, the USAF is the second largest of the service branches. The number of Airmen ineligible for follow-up due to being stationed overseas and other reasons limits generalizability of the findings. Finally, our follow-up spanned only a 1-year period. Future work could examine trajectories of use of TNCPs among USAF trainees over a longer time period.

## 5. Conclusions

Our results contribute to the tobacco control field on initiation of use of TNCPs among military personnel. Significant initiation of TNCP use occurred in the first year following basic military training, among both men and women, in this large sample of USAF trainees. As in our prior work (Patten et al., 2019), the current findings reinforce the importance of examining gender influences in both theoretical and analytical models of TNCP use initiation, escalation, and entrenchment among military personnel. For women, having peers before BMT who do not use tobacco appears to be protective, while reporting tobacco use intentions increases risk for initiation among men. Gender-specific prevention interventions are therefore warranted.

### CRediT authorship contribution statement

**Christi A. Patten:** Conceptualization, Methodology, Investigation, Writing - original draft, Writing - review & editing. **Xin-Qun Wang:** Conceptualization, Data curation, Formal analysis, Software, Methodology, Writing - original draft, Writing - review & editing. **Melissa A. Little:** Conceptualization, Data curation, Investigation, Project administration, Supervision, Writing - original draft, Writing - review & editing. **Jon O. Ebbert:** Conceptualization, Methodology, Investigation, Writing - original draft, Writing - review & editing. **Gerald W. Talcott:** Conceptualization, Methodology, Data curation, Funding acquisition, Investigation, Project administration, Resources,

Supervision, Writing - review & editing. **Ann S. Hryshko-Mullen:** Conceptualization, Data curation, Investigation, Project administration, Resources, Supervision, Writing - review & editing. **Robert Klesges:** Conceptualization, Methodology, Data curation, Funding acquisition, Investigation, Project administration, Resources, Supervision, Writing - review & editing.

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## Disclaimers

The voluntary, fully informed consent of the subjects used in this research was obtained as required by 32 CFR 219 and DODI 3216.02\_AFI 40-402. The views expressed in this document are those of the authors and do not reflect the official views or policy of the Department of Defense or its components.

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