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**Electronic Cigarette Use and Related Factors among Active Duty Service Members in the U.S. Military**

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**Abstract**

**Introduction**

Electronic cigarettes (e-cigarettes) are increasingly used in the U.S.A. by young people. As young adults serve as the primary recruiting pool for military, active duty service members in military may be susceptible to using e-cigarettes. However, factors related to e-cigarette use in military population have rarely been studied. We aimed to identify factors associated with e-cigarette use and factors related to duration of use among active duty service members.

**Materials and Methods**

Subjects (*N* = 2,467) from Fort Bragg Army Base, North Carolina and Lackland Air Force Base, Texas completed a self-administered questionnaire during July 2015 to May 2016 time frame. The questionnaire collected data on demographic and military characteristics, tobacco use (including e-cigarette use) and other information. Stepwise logistic regression was performed to identify significant factors associated with e-cigarette use. Stepwise linear regression was performed to identify factors associated with duration of use.

**Results**

A total of 356 (14.4%) study participants reported ever use of e-cigarettes. There was no significant difference in prevalence of use between the two military installations (15.6% at Fort Bragg vs. 13.2% at Lackland, *P* = 0.097). Increased use of e-cigarettes was associated with young age (20–24 years old) (OR = 1.98, 95% CI = 1.22–3.22), enlisted military rank (E1–E4: OR = 2.45, 95% CI = 1.36–4.40; E5–E9: OR = 1.88, 95% CI = 1.10–3.21), low perception of harm (OR = 5.18, 95% CI = 3.65–7.34), former (OR = 9.12, 95% CI = 6.29–13.22) and current (OR = 13.24, 95% CI = 9.22–19.02) cigarette smoking, and former smokeless tobacco use (OR = 2.07, 95% CI = 1.33–3.22), former (OR = 2.62, 95% CI = 1.42–4.85) and current (OR = 2.82, 95% CI = 1.82–4.37) cigar or pipe smoking. However, serving mainly in combat unit during deployment was associated with decreased odds of use (OR = 0.57, 95% CI = 0.34–0.97). Among e-cigarette users, the number of years using e-cigarettes was significantly longer among the participants with lower perception of harm than those with higher perception of harm (0.82 vs. 0.22, *P* < 0.001), and the duration was longer among subjects who used e-cigarette with nicotine than those without nicotine (0.79 vs. 0.49, *P* = 0.003). Finally, reasons for use differed markedly by cigarette smoking status. Never smokers used e-cigarette for the taste or flavor, while cigarette smokers used e-cigarette to help quit tobacco or reduce tobacco use.

**Conclusion**

Young age, lower military ranks, other tobacco use, and low perception of harm were associated with increased odds of using e-cigarettes, while serving in combat unit was associated with decreased odds of use in active duty service members. Low harm perception and using nicotine-containing e-cigarettes were associated with long duration of use. The reasons for using e-cigarettes differed by cigarette smoking status. Our study provides clues for future hypothesis-driven studies.

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**INTRODUCTION**

Electronic cigarettes (e-cigarettes) include a diverse group of devices that allow users to inhale an aerosol, which typically contains nicotine, flavorings, and other additives.[1](javascript:;),[2](javascript:;) With widespread advertising via multiple channels such as television commercials and social media, sales of e-cigarettes in the U.S.A. have risen rapidly since its introduction to the market and the prevalence of e-cigarette use has increased markedly since 2007, especially among young people.[1](javascript:;),[2](javascript:;)

Although e-cigarette aerosol contains lower levels of most toxicants than smoke from conventional combustible tobacco, a main public health concern for e-cigarette use is that nicotine exposure through its use might introduce a gateway for youth or young adults to subsequent combustible tobacco smoking.[3](javascript:;) On the other hand, however, e-cigarettes might increase tobacco cessation for adult cigarette smokers although this is not supported by all studies.[3](javascript:;),[4](javascript:;) Controversies exist in literature regarding the net public health effect of e-cigarettes. Moreover, due to the lack of longitudinal exposure and health outcome data, the long-term health effects of e-cigarette use are unknown.[1](javascript:;),[3](javascript:;),[5](javascript:;) The Committee on the Review of the Health Effects of Electronic Nicotine Delivery Systems reported “conclusive evidence” that “e-cigarette use increases airborne concentrations of particulate matter and nicotine in indoor environments compared with background levels”; and there is a “significant evidence” that “some chemicals present in e-cigarette aerosols (eg, formaldehyde, acrolein) are capable of causing DNA damage and mutagenesis.”[3](javascript:;)

Active duty service members in the military may be susceptible to using e-cigarettes because young adults serve as the primary recruiting pool for military. According to the most recent Department of Defense Health Related Behaviors Survey (2015 HRBS), 35.7% service members have used e-cigarettes and 12.4% were current (ie, past month) users,[6](javascript:;) as compared to 12.6% and 3.7%, respectively, in the U.S. general population during a similar time period (in 2014).[7](javascript:;) Active duty military members may differ from the general population in factors that may affect the use of e-cigarettes. Research on factors related to e-cigarette use in the U.S. military population is limited with a few published studies,[8–10](javascript:;), and the published studies are mostly descriptive with a limited number of factors studied. Given the high prevalence of e-cigarette use in the military and the characteristics of military population, further research is needed to investigate more factors, especially military-related factors in order to gain a better understanding of e-cigarette use in the military. Furthermore, as the long-term health effects of e-cigarettes are not yet clear, data on product and user factors related to exposure duration are valuable to aid design of studies evaluating long-term health effect of e-cigarettes. To date, no studies have investigated factors that are associated with duration of e-cigarette use in military populations.

Finally, because the active duty military population is mainly comprised of young people whose tobacco use habits have not been fully established, and they are at a vulnerable stage of experimenting different tobacco products, studying the reasons for using e-cigarettes may help provide clues for tobacco control and education. The goals of the present study are to: (1) identify factors associated with e-cigarette use in the study population of active duty service members, (2) identify factors related to duration of e-cigarette use, and (3) investigate self-reported reasons for using e-cigarettes by cigarette smoking status.

**METHODS**

**Study Population and Data Collection**

The study population and data collection were previously described.[11](javascript:;),[12](javascript:;) Study subjects were active duty service members stationed at Fort Bragg Army Base, North Carolina, and Lackland Air Force Base, Texas. The U.S. military conducts mandated annual dental exam for every active duty service member. All service members who visited the dental clinics at Fort Bragg and Lackland for their annual dental exam were given the opportunity to participate in a tobacco use survey. If they chose to participate, they were provided with an anonymous self-administered questionnaire to complete during their waiting time and then turned in the completed questionnaire before they left the clinic. The questionnaire contained 81 items and took approximately 20 minutes to 30 minutes to complete. There was no compensation for participation. Subject recruitment occurred from July 2015 to May 2016. The study had a recruitment goal of 2,500 participants (1,250 at each site). Subject recruitment stopped once the recruitment goal was reached. All questionnaires were anonymous. The study protocol is exempted by the Institutional Review Board (IRB) of Walter Reed National Military Medical Center.

The questionnaire collected information on demographics (age, sex, race, ethnicity, marital status, and education), military characteristics (military rank, years in military, deployment history, deployment times, whether served in combat units during deployment), cigarette smoking history (current smoking status, age at initiation, years of smoking, years of quitting if applicable, number of cigarettes per day, advisement of cigarettes on military installations, intention to quit, barriers to quit, military peer influence, etc.), smokeless tobacco use (similar information as cigarette smoking), and electronic cigarette use (see below for details). Respondents also answered questions about cigar or pipe smoking, secondhand smoke exposure, and alcohol use.

For e-cigarette use, participants were asked whether they used or use e-cigarettes, and if yes, were asked about duration of use (years and months) and type of e-cigarettes used (e-cigarettes with nicotine or e-cigarettes without nicotine). They were also asked about their perception of harm using e-cigarettes vs. cigarette smoking (the choices were “less harmful than cigarettes,” “equally harmful as cigarettes,” “more harmful than cigarettes,” or “do not know”) and whether they had seen promotions of e-cigarettes on military installations (“Yes, often,” “Yes, sometimes,” “Yes, but rarely,” or “No, never”). Finally, reasons for using e-cigarettes (“help quit tobacco or reduce tobacco use,” “deal with withdrawal symptoms,” “avoid bothering others with tobacco smoke,” “deal with situations where one cannot smoke,” “like the taste or flavor,” “cheaper than smoking or smokeless tobacco”) were queried by having respondents choosing from the list of reasons.

The final analysis in this study included 2,467 subjects with complete information on e-cigarette use. Participants (*N* = 33) who had missing or unknown information on e-cigarette use were excluded from the analysis.

**Statistical Analysis**

Distributions of demographics, military characteristics, perception of harms, cigarette smoking, smokeless tobacco use, cigar or pipe smoking, secondhand smoke exposure, and alcohol use by the status of e-cigarette use were compared using the χ2 test. We then performed univariate logistic regression to assess the associations among demographic, military, tobacco use and alcohol use variables, and e-cigarette use. Variables with a significant association with e-cigarette use in the univariate logistic regression (*P* < 0.05) were candidate variables for the stepwise logistic regression model. Stepwise logistic regression was performed to identify factors significantly associated with e-cigarette use from candidate variables. The assumption of independence of errors was met. Similarly, to identify significant factors associated with self-reported duration of use (in years), we first performed univariate linear regression to identify candidate variables. Any variables showing a significant association (*P* < 0.05) with duration of use entered into stepwise linear regression models as candidate variables. Stepwise linear regression was performed to identify significant factors from candidate variables associated with duration of use. Finally, self-reported reasons for using e-cigarettes were compared by cigarette smoking status using χ2 test. All statistical analyses were done by SAS 9.4 (Cary, Texas). All tests were two-sided with a significance level of 0.05.

**RESULTS**

Among the 2,467 subjects, 356 (14.4%) reported being e-cigarette users. The proportions of ever use were 15.6% at the Fort Bragg site and 13.2% at the Lackland site that were not statistically different (*P* = 0.097). Comparisons of users and nonusers ([Table I](javascript:;)) showed that users were more likely to be young (*P* < 0.001), male (*P* < 0.001), unmarried (*P* = 0.22), or enlisted (*P* < 0.001) or have less education (*P* < 0.001) and had served military for a shorter period (*P* < 0.001). Users were also more likely to see promotion (or advertisements) of e-cigarettes (*P* = 0.025), to perceive less harm of using e-cigarettes than smoking cigarettes (*P* < 0.001); be other substance users including cigarette, smokeless tobacco, cigar or pipe, and alcohol (*P* < 0.001 for all); and be exposed to secondhand smoke (*P* < 0.001). However, they were less likely to have deployed (*P* = 0.028) or served in combat units during deployment (*P* = 0.007).

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**TABLE I**

Characteristics of the Study Population by E-cigarette use Status at Fort Bragg Army Base and Lackland Air Force Base

| **Variables**[*a*](javascript:;) | **Nonuser** | | **User** | | ***P*-value** |
| --- | --- | --- | --- | --- | --- |
| ***N*** | **%** | ***N*** | **%** |
| Study site |  |  |  |  | 0.097 |
| Fort Bragg | 1,050 | 49.74 | 194 | 54.49 |  |
| Lackland | 1,061 | 50.26 | 162 | 45.51 |  |
| Age |  |  |  |  | <0.001 |
| 18–19 | 190 | 9.08 | 35 | 9.89 |  |
| 20–24 | 551 | 26.33 | 144 | 40.68 |  |
| 25–29 | 520 | 24.84 | 77 | 21.75 |  |
| 30 or older | 832 | 39.75 | 98 | 27.68 |  |
| Gender |  |  |  |  | <0.001 |
| Male | 1,622 | 77.13 | 307 | 86.24 |  |
| Female | 481 | 22.87 | 49 | 13.76 |  |
| Race |  |  |  |  | 0.550 |
| White | 1,388 | 66.06 | 232 | 65.17 |  |
| Black | 292 | 13.90 | 44 | 12.36 |  |
| Asian or Pacific Islander | 74 | 3.52 | 17 | 4.78 |  |
| Other | 347 | 16.52 | 63 | 17.70 |  |
| Ethnicity |  |  |  |  | 0.439 |
| Hispanic | 324 | 15.61 | 61 | 17.23 |  |
| Nonhispanic | 1,752 | 84.39 | 293 | 82.77 |  |
| Marital status |  |  |  |  | 0.022 |
| Married | 1,121 | 53.20 | 164 | 46.20 |  |
| Widowed, divorced, or separated | 203 | 9.63 | 47 | 13.24 |  |
| Have never been married | 783 | 37.16 | 144 | 40.56 |  |
| Highest education level |  |  |  |  | <0.001 |
| High school or lower | 415 | 19.67 | 108 | 30.34 |  |
| Associate degree or some college | 956 | 45.31 | 197 | 55.34 |  |
| Bachelor’s degree or higher | 739 | 35.02 | 51 | 14.33 |  |
| Current military rank |  |  |  |  | <0.001 |
| E1–E4 | 885 | 42.14 | 213 | 59.83 |  |
| E5–E9 | 717 | 34.14 | 119 | 33.43 |  |
| O1–O10, WO1–WO5 | 498 | 23.71 | 24 | 6.74 |  |
| Years in military |  |  |  |  | <0.001 |
| <5 years | 973 | 47.19 | 201 | 57.93 |  |
| 5–9 years | 441 | 21.39 | 72 | 20.75 |  |
| 10 years or longer | 648 | 31.43 | 74 | 21.33 |  |
| Ever deployed to combat zone |  |  |  |  | 0.028 |
| No | 1,136 | 54.17 | 214 | 60.45 |  |
| Yes | 961 | 45.83 | 140 | 39.55 |  |
| Times deployed to combat zone |  |  |  |  | 0.125 |
| Never deployed to combat zone | 1,136 | 54.17 | 214 | 60.45 |  |
| Once | 393 | 18.74 | 59 | 16.67 |  |
| Twice | 227 | 10.82 | 37 | 10.45 |  |
| Three times or more | 341 | 16.26 | 44 | 12.43 |  |
| Unit served during last deployment |  |  |  |  | 0.007 |
| Never deployed | 1,076 | 52.18 | 203 | 58.00 |  |
| Combat support units | 526 | 25.51 | 75 | 21.43 |  |
| Combat support and combat units equally | 138 | 6.69 | 34 | 9.71 |  |
| Combat units | 322 | 15.62 | 38 | 10.86 |  |
| Ever saw promotions for e-cigarettes |  |  |  |  | 0.025 |
| Yes, often | 103 | 4.9 | 20 | 5.62 |  |
| Yes, sometimes or rarely | 441 | 20.96 | 97 | 27.25 |  |
| No, never | 1,147 | 54.52 | 185 | 51.97 |  |
| Do not know/not sure | 413 | 19.63 | 54 | 15.17 |  |
| Perception of harm |  |  |  |  | <0.001 |
| Less harmful than cigarettes | 676 | 32.21 | 239 | 67.13 |  |
| Equally as or more harmful than cigarettes | 758 | 36.11 | 65 | 18.26 |  |
| Do not know | 665 | 31.68 | 52 | 14.61 |  |

*continued*

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**TABLE I**

Continued

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| Cigarette smoking |  |  |  |  | <0.001 |
| Nonsmoker | 1,699 | 80.79 | 102 | 28.65 |  |
| Former smoker | 233 | 11.08 | 115 | 32.30 |  |
| Current smoker | 171 | 8.13 | 139 | 39.04 |  |
| Smokeless tobacco use |  |  |  |  | <0.001 |
| Nonuser | 1,701 | 81.35 | 204 | 57.95 |  |
| Former user | 128 | 6.12 | 59 | 16.76 |  |
| Current user | 262 | 12.53 | 89 | 25.28 |  |
| Cigar or pipe smoking |  |  |  |  | <0.001 |
| Nonuser | 1,945 | 92.31 | 273 | 77.12 |  |
| Former user | 54 | 2.56 | 27 | 7.63 |  |
| Current user | 108 | 5.13 | 54 | 15.25 |  |
| Secondhand smoke exposure |  |  |  |  | <0.001 |
| No | 1,503 | 71.20 | 199 | 55.90 |  |
| Yes | 597 | 28.28 | 155 | 43.54 |  |
| Alcohol use |  |  |  |  |  |
| Nondrinker | 423 | 20.07 | 43 | 12.18 | <0.001 |
| Current regular drinker | 764 | 36.24 | 179 | 50.71 |  |
| Former regular drinker | 139 | 6.59 | 29 | 8.22 |  |
| Nonregular drinker | 782 | 37.10 | 102 | 28.90 |  |

*a*Total of some variables do not add up to grand total due to missing values.

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Among all variables considered (listed in [Table I](javascript:;)), age, gender, education, military rank, military years, ever deployed, unit served during deployment, perception of harm, cigarette smoking, smokeless tobacco use, cigar or pipe smoking, secondhand smoke exposure, and alcohol use were each significantly associated with e-cigarette use in univariate logistic regression and entered as candidate variables in the stepwise logistic regression model ([Table II](javascript:;)). The following variables were identified after stepwise selection: age 20 to 24 (OR = 1.98, 95% CI = 1.22–3.22), low military rank (E1–E4: OR = 2.70, 95% CI = 1.50–4.85; E5–E9: OR = 1.88, 95% CI = 1.10–3.21), low perception of harm (OR = 5.18, 95% CI = 3.65–7.34), current cigarette smoking (OR = 13.24, 95% CI = 9.22–19.02), former cigarette smoking (OR = 9.12, 95% CI = 6.29–13.22), former smokeless tobacco use (OR = 2.07, 95% CI = 1.33–3.22), current cigar or pipe smoking (OR = 2.82, 95% CI = 1.82–4.37), and former cigar or pipe smoking (OR = 2.62, 95% CI = 1.42–4.85) ([Table II](javascript:;)). In contrast, serving in only combat units during deployment was identified to be associated with decreased odds of use (OR = 0.57, 95% CI = 0.34–0.97), while serving in both combat units and combat support units during deployment was associated with increased odds of using e-cigarettes (OR = 1.75; 95% CI = 1.00–3.09) ([Table II](javascript:;)). Gender, education, years in military, ever deployed to combat zone, secondhand smoke exposure, and alcohol use dropped out of the model.

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**TABLE II**

Factors Significantly Associated with E-cigarette use in Univariate and Stepwise Logistic Regressions

| **Variables** | **Univariate** | | | **Multivariable (stepwise)** | |
| --- | --- | --- | --- | --- | --- |
| **No use/use** | **Odds ratio** | **95% CI**[*a*](javascript:;) | **Odds ratio** | **95% CI**[*a*](javascript:;) |
| Age |  |  |  |  |  |
| 30 or older | 832/98 | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) |
| 25–29 | 520/77 | 1.26 | 0.92–1.73 | 1.13 | 0.74–1.71 |
| 20–24 | 551/144 | 2.22 | 1.68–2.93 | 1.98 | 1.22–3.22 |
| 18–19 | 190/35 | 1.56 | 1.03–2.37 | 1.69 | 0.88–3.24 |
| Gender |  |  |  |  |  |
| Male | 1,622/307 | 1.00 (ref.) | 1.00 (ref.) |  |  |
| Female | 481/49 | 0.54 | 0.39–0.74 |  |  |
| Highest education level |  |  |  |  |  |
| High school or lower | 415/108 | 1.00 (ref.) | 1.00 (ref.) |  |  |
| Associate degree or some college | 956/197 | 0.79 | 0.61–1.03 |  |  |
| Bachelor’s degree or higher | 739/51 | 0.27 | 0.19–0.38 |  |  |
| Current military rank |  |  |  |  |  |
| O1–O10, WO1–WO5 | 498/24 | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) |
| E5–E9 | 717/119 | 3.44 | 2.19–5.42 | 1.88 | 1.10–3.21 |
| E1–E4 | 885/213 | 4.99 | 3.23–7.72 | 2.70 | 1.50–4.85 |
| Years in military |  |  |  |  |  |
| <5 years | 973/201 | 1.00 (ref.) | 1.00 (ref.) |  |  |
| 5–9 years | 441/72 | 0.79 | 0.59–1.06 |  |  |
| 10 years or longer | 648/74 | 0.55 | 0.42–0.74 |  |  |
| Ever deployed to combat zone |  |  |  |  |  |
| No | 1,136/214 | 1.00 (ref.) | 1.00 (ref.) |  |  |
| Yes | 961/140 | 0.77 | 0.62–0.97 |  |  |
| Unit served during deployment |  |  |  |  |  |
| Never deployed | 1,076/203 | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) |
| Combat unit | 322/38 | 0.63 | 0.43–0.90 | 0.57 | 0.34–0.97 |
| Combat support unit | 526/75 | 0.76 | 0.57–1.01 | 1.09 | 0.72–1.65 |
| Combat and combat support equally | 138/34 | 1.31 | 0.87–1.96 | 1.75 | 1.00–3.09 |
| Perception of harm |  |  |  |  |  |
| Equally or more harmful than cigarettes | 758/65 | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) |
| Less harmful than cigarettes | 676/239 | 4.13 | 3.08–5.53 | 5.18 | 3.65–7.34 |
| Do not know | 665/52 | 0.91 | 0.62–1.33 | 0.92 | 0.60–1.40 |
| Cigarette smoking |  |  |  |  |  |
| Nonsmoker | 1,699/102 | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) |
| Former smoker | 233/115 | 8.22 | 6.09–11.09 | 9.12 | 6.29–13.22 |
| Current smoker | 171/139 | 13.54 | 10.03–18.28 | 13.24 | 9.22–19.02 |
| Smokeless tobacco use |  |  |  |  |  |
| Nonuser | 1,701/204 | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) |
| Former user | 128/59 | 3.84 | 2.73–5.41 | 2.07 | 1.33–3.22 |
| Current user | 262/89 | 2.83 | 2.14–3.75 | 1.36 | 0.94–1.97 |
| Cigar or pipe smoking |  |  |  |  |  |
| Nonuser | 1,945/273 | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) | 1.00 (ref.) |
| Former user | 54/27 | 3.56 | 2.21–5.75 | 2.62 | 1.42–4.85 |
| Current user | 108/54 | 3.56 | 2.51–5.06 | 2.82 | 1.82–4.37 |
| Secondhand smoke exposure |  |  |  |  |  |
| No | 1,503/199 | 1.00 (ref.) | 1.00 (ref.) |  |  |
| Yes | 597/155 | 1.96 | 1.56–2.70 |  |  |
| Alcohol use |  |  |  |  |  |
| Nondrinker | 423/43 | 1.00 (ref.) | 1.00 (ref.) |  |  |
| Current regular drinker | 764/179 | 2.31 | 1.62–3.28 |  |  |
| Former regular drinker | 139/29 | 2.05 | 1.23–3.41 |  |  |
| Nonregular drinker | 782/102 | 1.28 | 0.88–1.87 |  |  |

*a*95% CI = 95% confidence interval.

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We next identified factors associated with duration of use. Among all variables that applied to e-cigarette users (all variables listed in [Table I](javascript:;); and e-cigarette type, which only applies to users and thus is not listed in [Table I](javascript:;)), study site, education, perception of harms, cigarette smoking status, and e-cigarette type each showed significant associations with duration of use in the univariate linear regression model ([Table III](javascript:;)) and entered in the stepwise linear regression model as candidate variables. Among candidate variables, only perception of harm and e-cigarette type were identified to be significant in the stepwise model ([Table III](javascript:;)). Specifically, duration of use was significantly longer among subjects with lower perception of harm using e-cigarettes (lower vs. equal or higher perception of harm: 0.82 years vs. 0.22 years, *P* < 0.001), and among subjects who used e-cigarettes with nicotine (e-cigarettes with nicotine vs. without nicotine: 0.79 years vs. 0.49 years, *P* = 0.003) ([Table III](javascript:;)). Study site, education, and cigarette smoking status dropped out of the model.

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**TABLE III**

Duration of E-cigarette use (in Years) by Significant Factors in Univariate Linear Regression and Stepwise Linear Regression Models

|  | **Univariate** | | | **Multivariable (Stepwise)** | | |
| --- | --- | --- | --- | --- | --- | --- |
| ***N*** | **Mean (SE)** | ***P*-value** | ***N*** | **Mean (SE)** | ***P*-value** |
| By site |  |  | 0.049 |  |  |  |
| Fort Bragg | 183 | 0.75 (0.06) |  |  |  |  |
| Lackland | 147 | 0.96 (0.09) |  |  |  |  |
| By highest education level |  |  | 0.038 |  |  |  |
| High school or lower | 101 | 0.91(0.09) |  |  |  |  |
| Associate degree or some college | 181 | 0.84 (0.06) |  |  |  |  |
| Bachelor degree or higher | 48 | 0.72 (0.19) |  |  |  |  |
| By perception of harms |  |  | <0.001 |  |  | <0.001 |
| Less harmful than cigarettes | 228 | 1.01 (0.07) |  | 228 | 0.82 (0.09)*[a](javascript:;)*,[*b*](javascript:;) |  |
| Equally or more harmful | 60 | 0.39 (0.06) |  | 60 | 0.22 (0.13)*[c](javascript:;)*,[*b*](javascript:;) |  |
| Do not know | 42 | 0.60 (0.10) |  | 42 | 0.48 (0.14)*[c](javascript:;)*,[*b*](javascript:;) |  |
| By cigarette smoking |  |  | 0.002 |  |  |  |
| Nonsmoker | 91 | 0.69 (0.10) |  |  |  |  |
| Previous smoker | 107 | 1.06 (0.09) |  |  |  |  |
| Current smoker | 132 | 0.78 (0.08) |  |  |  |  |
| By e-cigarette type |  |  | <0.001 |  |  | 0.003 |
| With nicotine | 225 | 0.96 (0.07) |  | 225 | 0.79 (0.07)*[a](javascript:;)*,[*b*](javascript:;) |  |
| Without nicotine | 76 | 0.66 (0.07) |  | 76 | 0.49 (0.11)*[c](javascript:;)*,[*b*](javascript:;) |  |
| Do not know | 20 | 0.28 (0.07) |  | 20 | 0.24 (0.20)*[c](javascript:;)*,[*b*](javascript:;) |  |

SE = standard error.

*a*(p<0.05).

*b*Values not sharing a same letter are significantly different from each other in pairwise comparisons.

*c*(p>0.10).

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We finally compared self-reported reasons for using e-cigarettes ([Table IV](javascript:;)). Among the reasons queried (“help quit tobacco or reduce tobacco use,” “deal with withdrawal symptoms,” “avoid bothering others with tobacco smoke,” “deal with situations where one cannot smoke,” “like the taste or flavor,” “cheaper than smoking or smokeless tobacco”), the top two reasons were “help quit tobacco or reduce tobacco use” (51.12%) and “like the taste or flavor” (50%). When data were analyzed by cigarette smoking status, the distribution of subjects reporting a particular reason significantly differed by subjects’ smoking status ([Table IV](javascript:;)). Among noncigarette smokers, the top one reason for using e-cigarettes was “like the taste or flavor” (70.59%), while among previous and current smokers, the top one reason was “help quit tobacco or reduce tobacco use” (66.96% and 66.91%, respectively).

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**TABLE IV**

Self-reported Reasons for Using E-cigarettes and by Cigarette Smoking Status

|  | **Overall** | | **Never smoker**[*a*](javascript:;) | | **Previous smoker** | | **Current smoker** | | ***P*-value** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***N*** | **%** | ***N*** | **%** | ***N*** | **%** | ***N*** | **%** |
| Help quit tobacco or reduce tobacco use |  |  |  |  |  |  |  |  | <0.001 |
| Yes | 182 | 51.12 | 12 | 11.76 | 77 | 66.96 | 93 | 66.91 |  |
| No | 174 | 48.88 | 90 | 88.24 | 38 | 33.04 | 46 | 33.09 |  |
| Deal with withdrawal symptoms |  |  |  |  |  |  |  |  | <0.001 |
| Yes | 59 | 16.57 | 3 | 2.94 | 24 | 20.87 | 32 | 23.02 |  |
| No | 297 | 83.43 | 99 | 97.06 | 91 | 79.13 | 107 | 76.98 |  |
| Avoid bothering others with tobacco smoke |  |  |  |  |  |  |  |  | 0.002 |
| Yes | 64 | 17.98 | 8 | 7.84 | 20 | 17.39 | 36 | 25.90 |  |
| No | 292 | 82.02 | 94 | 92.16 | 95 | 82.61 | 103 | 74.10 |  |
| Deal with situations where one cannot smoke |  |  |  |  |  |  |  |  | <0.001 |
| Yes | 69 | 19.38 | 9 | 8.82 | 20 | 17.39 | 40 | 28.78 |  |
| No | 287 | 80.62 | 93 | 91.18 | 95 | 82.61 | 99 | 71.22 |  |
| Like the taste or flavor |  |  |  |  |  |  |  |  | <0.001 |
| Yes | 178 | 50.00 | 72 | 70.59 | 54 | 46.96 | 52 | 37.41 |  |
| No | 178 | 50.00 | 30 | 29.41 | 61 | 53.04 | 87 | 62.59 |  |
| Cheaper than smoking or smokeless tobacco |  |  |  |  |  |  |  |  | 0.039 |
| Yes | 64 | 17.98 | 10 | 9.80 | 24 | 20.87 | 30 | 21.58 |  |
| No | 292 | 82.02 | 92 | 90.20 | 91 | 79.13 | 109 | 78.42 |  |

*a*Never smokers could be users of smokeless tobacco, cigar, or pipe users.

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**DISCUSSION**

In this study of active duty military population, we identified young age, low military ranks, other tobacco use, and lower perception of harm as factors that are associated with increased odds of using e-cigarettes, while serving in combat unit was associated with decreased odds of use. Furthermore, low harm perception and using nicotine-containing e-cigarettes were associated with long duration of use. Finally, the reasons for using e-cigarettes differed by cigarette smoking status. Never smokers used e-cigarette for the taste or flavor, while cigarette smokers used e-cigarette for the reason of helping quit tobacco or reduce tobacco use.

Our study found that the prevalence of using e-cigarettes in the study population was 14.4% without a significant difference between the two study sites (15.6% at the Fort Bragg site and 13.2% at the Lackland site, *P* = 0.097). In literature, the “ever use” prevalence rate was 61% in a U.S. Army Infantry division[8](javascript:;) and 31.4% in a study of U.S. Naval personnel, respectively, during a similar time period as our study.[9](javascript:;) Both our study and the previous studies collected data from specific military installations and the results suggested a large variation in prevalence of e-cigarette use among military installations. The reasons for the large variation are unknown, but as the study populations were not selected to represent U.S. military, the variation may be related to specific population surveyed. The 2015 DoD HRBS, a survey representative of U.S. active duty military, reported that 35.7% service members had ever used e-cigarettes with 12.4% current users.[6](javascript:;) In addition to the difference by site, in our study, further examination of the user profiles showed that young age, White race, male, married or never married, and having an associate degree or some college education were the main demographic characteristics of users, which are consistent with data from national surveys and other population studies.[13–15](javascript:;) In studies of military populations,[8](javascript:;),[9](javascript:;) young age, male, less than college education were also reported to be demographic characteristics e-cigarette user. However, because our study populations were not sampled to represent U.S. military, the user profiles in our study may not represent characteristics of all military users.

In the analysis of associated factors with e-cigarette use, we found that young age, enlisted rank, low harm perception of use, use of cigarettes, and other tobacco products were significantly and independently associated with increased likelihood of using e-cigarettes in the study population. Similar results were reported in other U.S. military population studies.[8–10](javascript:;) However, compared to previous studies, we considered a larger panel of potential factors, especially multiple military-related factors, such as deployment history and units served during deployment, factors that were not previously studied in their relationships to e-cigarette use.

The finding that young military enlisted personnel 20 to 24 years old had the highest likelihood of using e-cigarettes is consistent with the national pattern. Young people are more likely to use e-cigarettes than old people probably because e-cigarettes are heavily marketed in a wide variety of channels with broad reach to youth and young adults. According to the most recent Surgeon General’s Report,[1](javascript:;) current use of e-cigarettes by young adults of age 24 or younger surpassed that of adults of age 25 years or older.

Consistent with the observations from the general population[14](javascript:;),[15](javascript:;) and military population, [8](javascript:;),[10](javascript:;) former users of all other tobacco products, including cigarettes, cigars/pipes, and smokeless tobacco had increased odds of using e-cigarettes. This may be an indication of their intention to quit other tobacco products by switching to e-cigarettes. E-cigarettes were reported as a cessation tool among smokers in other studies.[9](javascript:;),[16](javascript:;) Indeed, the top reason for using e-cigarettes among former smokers (67%) was “help quit tobacco or reduce tobacco use” in our study population. While the users have the intention to use e-cigarettes to help quit tobacco, there has been much debate in literature on whether using e-cigarettes could promote tobacco cessation.[17–24](javascript:;) In some studies, including those based on national-represented samples,[20](javascript:;),[25](javascript:;) frequent use of e-cigarettes was associated with smoking cessation, but the results from meta-analysis and systematic reviews were not consistent.[17](javascript:;),[26](javascript:;),[27](javascript:;) Based on the evidence from systematic reviews, prospective cohort studies and repeated cross-sectional studies, the Committee on the Review of the Health Effects of Electronic Nicotine Delivery Systems concluded that the evidence that e-cigarettes may be an effective aid to promote smoking cessation is still limited and future long-term studies are warranted.[3](javascript:;)

In addition to young age and former tobacco use, lower perception of harm was another significant factor identified. The increased likelihood of using e-cigarettes if the product was perceived “less harmful than cigarettes” was also observed in other studies.[8](javascript:;),[28](javascript:;) In a population of U.S. Army Infantry Division, more than 50% of the study participants felt that e-cigarettes were less harmful than cigarettes.[8](javascript:;) The low perceived harm compared to other tobacco products was among the most cited reasons for using e-cigarettes among the U.S. young adults.[1](javascript:;) This may be related to the reduced toxin levels from e-cigarettes and the use being less harmful in terms of short-term health outcomes than combustible tobacco cigarettes.[29–32](javascript:;) However, the long-term health effects of using e-cigarettes are still not well understood.[3](javascript:;) Therefore, users with low perception of harm should be advised about the uncertainty of long-term health effects due to lack of longitudinal data.

We previously reported significant positive association between serving in a combat unit and smokeless tobacco use in the same study population.[11](javascript:;) In this study, however, there was an inverse association between e-cigarette use and serving in a combat unit during deployment. Tobacco use is believed to serve as a coping mechanism for deployment-related stress.[33](javascript:;),[34](javascript:;) Deployment and combat exposure are usually linked to increased cigarette smoking initiation and recidivism,[35](javascript:;),[36](javascript:;) as well as smokeless tobacco use.[11](javascript:;),[37](javascript:;) Exposure to nicotine from e-cigarettes, however, highly depends on product and user characteristics.[3](javascript:;) In particular, plasma nicotine levels are much lower for e-cigarettes compared to other tobacco products among naïve e-cigarette users.[38](javascript:;),[39](javascript:;) It is possible that the low nicotine intake from e-cigarette might not be sufficient for coping with deployment-related stress. It is also possible that e-cigarette use, which requires a vaping device and produces aerosol by heating, may be prohibited or less available in combat units, leading to decreased odds of using among those serving in only combat units. The reasons for the increased odds of using among those who served in both combat and combat support units are unclear. If use of e-cigarettes is prohibited in combat units to follow installation policy,[40](javascript:;) then for those who served in both combat and combat support units, the odds of using could increase when they served in noncombat units where the use was allowed, leading to increased overall odds of using. Our findings add to the current literature that serving in combat units during deployment was associated with decreased odds of use, while the odds of using increased if serving in both combat and combat support units.

Future studies are warranted to examine how users’ experience (naïve or experienced user), product type, and nicotine content could modify the association between deployment and e-cigarette use in military populations. Command and deployment station regulations may be among other reasons to be explored in future studies as well.

To the best of our knowledge, our study is the first to study factors in relation to duration of e-cigarette use in military population. Both low perception of harm and using e-cigarettes with nicotine were associated with longer duration of use. As discussed above, low harm perception was also a significant predictor of user status. Given its associations with both user status and duration of use, a message of uncertain long-term health outcome of using e-cigarettes should be conveyed in military tobacco education programs. The association between using e-cigarettes with nicotine and longer duration may suggest more nicotine addiction among experienced users (ie, those with longer duration of use).

As expected, self-reported reasons for using e-cigarettes differed markedly by cigarette smoking status. Flavor was the top reason for never smokers to use e-cigarettes (71%). As flavoring in tobacco is considered an attractive characteristic and is associated with temporary experimentation or initiation of tobacco use,[41](javascript:;),[42](javascript:;) a main public health concern for e-cigarette use is that they might provide a gateway for youth or young adults to subsequent combustible tobacco use.[1](javascript:;) Nonsmoking active duty members are young and may be susceptible to experimentation with new and emerging tobacco products. Thus, flavoring of e-cigarettes may attract them to use e-cigarettes and subsequently combustible tobacco. The Committee on the Review of the Health Effects of Electronic Nicotine Delivery Systems called for longitudinal cohort studies to understand the trajectory of dependence over time in users with little or no combustible tobacco product exposure.[3](javascript:;)

Our study has limitations. As a cross-sectional study, the associations between e-cigarette use and the identified factors may not imply a causal association. Although the study subjects were recruited from Army and Air Force installations, results should be interpreted with caution that the user profiles and associated factors identified in our study should not be extended to represent characteristics of all users from Army or Air Force. Finally, number of subjects in some subgroups was small that may limit the statistical power in subgroup analysis.

Our study has the strength of comprehensive data collection that allows a comprehensive assessment of a large pool of potential factors, especially military-related factors. Also, the study population is a large sample from two military installations with substantial number of e-cigarette users. Given the sparse e-cigarette use research in military population, our study contributes to the military tobacco research literature.

**CONCLUSIONS**

In conclusion, our study identify factors in relation to e-cigarette user status and is the first study to identify factors associated with duration of e-cigarette use in military population. Low harm perception was a factor significantly related to both user status and duration of use. Given its associations with both, a message of uncertain long-term health outcome of using e-cigarettes should be conveyed in military tobacco education programs, especially toward young enlisted military personnel who are vulnerable to e-cigarette use. Our findings provide clues for further hypothesis-driven studies and military tobacco research and tobacco control.

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