

# Socioecological Risk and Protective Factors for Smoking Among Active Duty U.S. Military Personnel

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**ABSTRACT** Introduction: Cigarette smoking can have negative consequences in military populations including injury, reduced physical endurance, higher frequency of sick days, and reduced combat readiness. This study used the socioecological model to understand individual, interpersonal, and organizational influences on cigarette smoking among military members. Materials and Methods: The sample for this secondary analysis was drawn from personnel at 24 large U.S. military installations, six from each service branch. Analyses included 4,728 personnel who were classified as current cigarette smokers. Generalized linear mixed models were used to estimate the associations among risk and protective factors from multiple ecological levels for smoking intensity and nicotine dependence. Results: Smoking to fit in with one's unit, being in the Army, smoking as a reaction to stress, and work-related stressors were all related to increased intensity of smoking and nicotine dependence. More active coping was associated with lower nicotine dependence and reduced smoking intensity. Conclusion: Results based on the socioecological model identify influencing factors and suggest possible interventions for smoking cessation. Reducing tobacco use in the military will require coordinated interventions that address multilevel determinants of use and improve military health. This is important to the strategic alignment of policy and services across the continuum of health care needs.

## INTRODUCTION

Cigarette smoking is a significant health behavior problem, contributing to diseases in nearly all major organs and causing more than 20 million premature deaths in the 50 yr following the first Surgeon General's 1964 report on the health effects of smoking.<sup>1</sup> In addition to the established physical health consequences of smoking, it is well documented that smoking contributes to negative career outcomes in military populations, including injuries, reduced physical endurance, financial strain, higher frequency of sick days, early military discharge, stress at work and home, and reduced combat readiness.<sup>2-9</sup>

In 1980, just over half of active duty military personnel were current smokers.<sup>10</sup> In 1986, the Department of Defense<sup>11</sup> increased efforts to curb tobacco use by military personnel through a comprehensive health promotion program that emphasized smoking prevention and cessation, established health education, and restricted personnel from smoking in official buildings, classrooms, and vehicles. This health promotion strategy was developed to encourage lifestyle changes, promote healthy behaviors as the norm, and foster the belief that unhealthy behaviors such as smoking were incompatible with military service. To further support health promotion efforts, the Secretary of Defense issued a memorandum calling for an intensive antismoking campaign that emphasized the negative health impact of smoking.<sup>12</sup>

Despite the various influences such as health education and cessation efforts that have decreased the cigarette smoking rate from 50% in 1980, cigarette smoking is still prevalent in the military. Approximately 24% of active duty personnel report currently smoking every day or some days, whereas about 19% of the general population are current smokers.<sup>13</sup> Even though there has been progress in reducing tobacco use, military tobacco reduction programs face several challenges. These include combating the myth that tobacco relieves stress,<sup>14</sup> debunking the idea that smoking or using tobacco products is part of being in the military, and curbing the frequent use of cigarettes as a break from work, which can lead to productivity loss.<sup>15</sup>

Risk factors for tobacco use are typically conceptualized as individual- and interpersonal-level factors (e.g., male gender, lower educational levels, and peer and parental influence), but these do not fully explain tobacco use behavior.<sup>1,16-18</sup> Past and present tobacco reduction programs typically target these individual and interpersonal factors and thus might be missing other important opportunities for interventions toward behavior change. Socioecological (SE) models were developed to further the understanding of the dynamic interrelations among various personal and environmental factors and their combined influence on behavior.<sup>19</sup> The core concept of an SE model is that behavior has multiple levels of influences, often including intrapersonal (biological and personal history), interpersonal (peers, intimate partners, and family), organizational/community (workplace), and policy (pricing and restrictions) factors.<sup>20,21</sup> Previous research has used the SE model to understand how multiple social systems contribute to the etiology of adolescent smoking in a civilian population,<sup>22</sup> but such utility has not been examined in the military.

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The SE approach has been used to examine health behaviors and in the design of interventions to address a variety of public health issues, including physical activity,<sup>23,24</sup> diet and eating behaviors,<sup>25</sup> and chronic disease self-management.<sup>26</sup> Although no studies use the SE model to understand military smoking, the model has been used in other military research to examine individual, social, and organizational influences on outcomes such as presence and severity of hazardous drinking among Air Force personnel<sup>27</sup> and emotional abuse among military couples.<sup>28</sup>

The SE model was used in this article as a framework for understanding the role of multiple influences on tobacco use outcomes among military members. Using a modified version of the Centers for Disease Control and Prevention SE model from the Institute of Medicine report on military tobacco use,<sup>20</sup> we examined the contribution of individual, interpersonal, and unit/organizational factors on cigarette smoking in a secondary analysis of a military health behavior survey.

**METHODS**

**Data Source and Subjects**

Data for the current analyses were drawn from a previous Department of Defense study of unit-level influences on alcohol and tobacco use.<sup>15</sup> The target population for the original study was all active duty military personnel stationed at 24 large military installations (six from each service: Army, Navy, Marine Corps, and Air Force) that represented the major power projection platforms in the continental United States and overseas. These installations had a large number

of personnel aged 18–25 yr in deployable combat and support units who were at high risk for tobacco use.

The original study used a stratified two-stage sampling design. Each installation formed a sampling stratum, and the numbers of unit-level companies, squadrons, and other divisions to be selected were allocated to each installation proportional to the total number of units at the installation. A total of 200 units were selected, 50 from each service with 25 from the continental United States and 25 from overseas. A simple random sample of proportionally allocated units was selected at each installation; a few selected units were replaced because of unit deployments or other reasons for not being available. The survey response rate was 75%.<sup>15</sup>

We received 15,221 usable completed questionnaires. Of these, this article analyzes responses from 4,728 personnel who were classified as current cigarette smokers, as determined by a positive response to the question “Are you currently a cigarette smoker?” The original study was approved by local and military Institutional Review Boards.

**Measures**

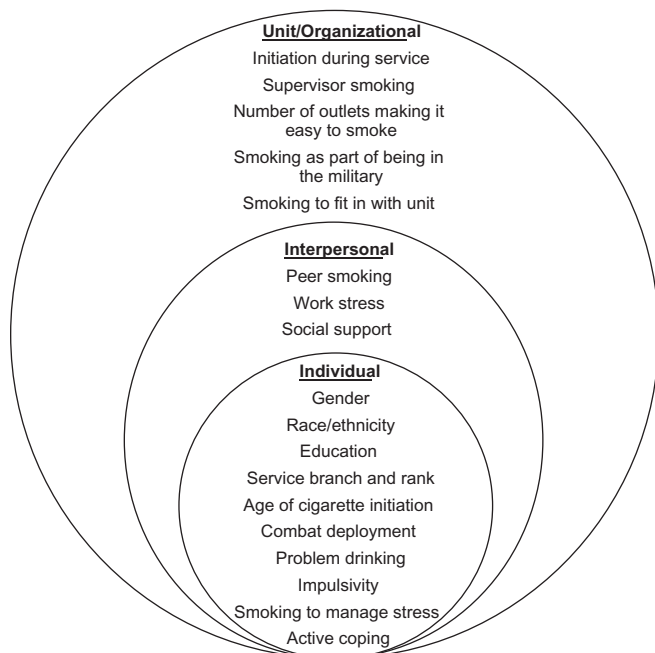
The survey questionnaire included a large number of items regarding risk and protective factors for tobacco use. From these, we selected items to reflect each of the three SE levels of risk factors (individual, interpersonal, and unit/organizational) and two protective factors, active coping and social support. Figure 1 displays how the SE model was operationalized for our analyses and the constructs included at each level. When multiple questionnaire items corresponded to components of the SE model (e.g., multiple indicators of peer influences on smoking behavior), these items were examined with confirmatory factor analysis (CFA) to determine whether a single latent factor score could be used in place of individual items. Latent factors were evaluated for fit using the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Adequate fit was indicated by the following cutoffs: 0.90 or higher for CFI, 0.10 or lower for RMSEA, and 0.08 or lower for SRMR. All latent factors were estimated in the full sample and have a mean of zero (Fig. 1).

**Individual Measures**

Sociodemographic variables included gender, race/ethnicity, education, military rank, and service branch. Items also included lifetime combat deployment and age of cigarette initiation.

**Problem Drinking**

The comorbidity measure of problem drinking levels and possible alcohol dependence was determined using the Alcohol Use Disorders Identification Test (AUDIT).<sup>29</sup> The AUDIT was developed by the World Health Organization to serve as a simple method of screening for excessive drinking and assist in brief assessment. The AUDIT consists of 10 questions, each scored from 0 to 4, with a total score ranging from 0 to



**FIGURE 1.** SE model of tobacco use outcomes.

40. Scores between 8 and 15 are indicative of hazardous drinking, scores between 16 and 19 suggest harmful drinking, and scores of 20+ warrant further diagnostic evaluation for alcohol dependence.

### **Impulsivity**

Comorbid impulsive behaviors were assessed with five items<sup>30</sup>: (a) I often act on the spur of the moment without stopping to think, (b) I get a real kick out of doing things that are a little dangerous, (c) you might say I act impulsively, (d) I like to test myself every now and then by doing something a little chancy, and (e) many of my actions seem to be hasty. Each item was scored using a four-point scale (0 = not at all, 1 = a little, 2 = some, and 3 = quite a lot). A mean score was created across items.

### **Stress Management (Latent Factor)**

Four interrelated items assessed cigarette use as a method for dealing with stress or frustration. A CFA indicated good model fit (CFI = 0.99, RMSEA = 0.02, and SRMR = 0.01), so the single-factor score was used in place of the individual items.

### **Interpersonal Measures**

#### **Peer Use (Latent Factor)**

Items measuring peer influence on current smoking were combined to form a peer use factor. Persons responded how likely they were to smoke cigarettes in the following situations: when I am with other people who are smoking, when I am offered a cigarette, and when I want to socialize. A fourth item assessed agreement with the statement: "Most of my friends in the military smoke or use other tobacco products." The CFA indicated that these four items could be represented by a latent factor with good fit (CFI = 0.99, RMSEA = 0.03, and SRMR = 0.02).

#### **Work Stress (Latent Factor)**

A work stress factor was created by including those who responded "Some" or "A Lot" to experiencing stress in the past 6 mo from any of the following: job frustrations, problems with work relationships, problems with a supervisor, and decreases in workload. Model fit for the latent factor was adequate by CFI (0.92) and SRMR (0.06), although RMSEA was somewhat high (0.21). The factor score was used in analyses.

### **Unit/Organizational Measures**

Five items were included to assess unit and organizational constructs. Two binary items were included: smoking was initiated during military service (yes/no) and supervisor smoked (yes/no). Two additional items were measured on a five-point Likert scale from "Strongly Disagree" to "Strongly Agree" (scored 1–5): the number of places to buy cigarettes and other tobacco products at this installation makes it easy to smoke, and smoking is part of being in the military. A final item,

measured on a four-point scale (scored 0–3) from "Never" to "Always," asked how often the following reason influenced their use of tobacco: to fit in with my military unit.

### **Protective Measures**

#### **Active Coping (Latent Factor)**

Six items assessed how frequently respondents engaged in specific active coping behaviors when they felt pressure, stress, or anxiety. These included talking to a friend or a family member, saying a prayer, exercising or playing sports, engaging in a hobby, getting something to eat, and thinking of a plan to solve the problem. The items showed adequate model fit with a CFA (CFI = 0.92, RMSEA = 0.09, and SRMR = 0.04).

#### **Social Support (Latent Factor)**

The construct of social support was generated using four survey items addressing military and nonmilitary relationships. Military-related support was assessed using three items that asked about support from the individual's supervisor, the unit being like family, and being able to go to someone in the unit with a personal problem. Nonmilitary support was assessed using one item that asked about family and friends being supportive. The social support factor exhibited satisfactory fit (CFI = 0.98, RMSEA = 0.09, and SRMR = 0.03), and the factor score was retained for use in later models.

### **Smoking Outcomes**

#### **Smoking Intensity**

For current cigarette smokers, intensity of smoking was categorized as light (10 or fewer cigarettes per day), moderate (11–20 cigarettes per day), or heavy (21 or more cigarettes per day).

#### **Nicotine Dependence**

Nicotine dependence among cigarette smokers was computed using the Fagerstrom Test for Nicotine Dependence.<sup>31</sup> The scale consists of six questions, with a total score ranging from 1 to 10. Scores of 1 or 2 were labeled not dependent, scores of 3 or 4 were labeled low dependence, scores of 5–7 were considered moderate dependence, and scores of 8 or higher were considered high dependence.

### **Analyses**

The smoking intensity and nicotine dependence outcomes each were composed of distinct categories suggested by important cutoffs and were therefore ordinal dependent variables (DVs). Before modeling associations of SE constructs with the outcomes, we evaluated the proportional odds assumption, or the assumption that the difference between categories was similar. The proportional odds assumption was not met for either outcome and so associations with each subsequent level of intensity and dependence were therefore modeled using a cumulative

(vs. proportional) logit model. To facilitate this, the intensity and dependence outcomes were recoded into  $k-1$  binary variables where  $k$  equals the number of categories of the DV. Each binary item compared the  $i$ th level or fewer categories to all categories greater than  $i$  (e.g., dependence levels 1 and 2 compared with levels 3 and 4). Together, the recoded DVs for each outcome represented steps or thresholds of dependence or intensity, which were then conditioned on predictors.

Generalized linear mixed models were used to estimate the association between the risk and protective factors detailed above with the smoking outcomes. Unit-level intraclass correlation coefficients (ICCs) for the recoded outcomes were modest and ranged from 0.02 to 0.03 for intensity and 0.04 to 0.06 across the dependence-level indicators. These unit-level ICCs were accommodated by inclusion of random effects for the military unit (i.e., respondents were clustered within unit). Separate models were estimated for each comparison variable derived from the recoded categorical DVs using SAS PROC GLIMMIX. All predictor items were entered simultaneously for each outcome.

**RESULTS**

Table I presents the percentages and mean values for all variables used in the regression models. The majority of the smokers were male, enlisted, and in either the Army or the Marine Corps. Slightly more than half of the sample (56.6%) had ever been combat deployed. Among current smokers, 46.5% were light smokers, 42.0% were moderate smokers, and 11.5% were heavy smokers. Rates for nicotine dependence were 39.8% for low dependence, 29.3% for low to moderate dependence, 26.6% for moderate dependence, and 4.3% for high dependence. A large proportion (78%) of respondents reported having a supervisor who smoked, and 41% reported starting to smoke since joining the military. Average age of smoking initiation was around 16 yr. Concerning alcohol use comorbidity, participants reported an average AUDIT score of 10.05, higher than the cutoff of 8+, which indicates hazardous drinking. The mean impulsivity score was 1.32, indicating on average slightly more than “a little” impulsive behavior.

Table II summarizes the model results for the smoking intensity outcome and contrasts (a) light smokers vs. moderate or heavy smokers and (b) light or moderate smokers vs. heavy smokers. As shown, most constructs were consistently related to greater smoking intensity across both steps or thresholds of use (i.e., low vs. moderate/heavy and low/moderate vs. heavy). Greater active coping was associated with a lower likelihood of more intense smoking across both thresholds. Being female and non-White were also associated with less intense smoking. Smokers who initiated cigarette use at older ages were less likely to be in higher smoking intensity categories as well. Smoking to fit in with one’s unit, being in the Army, smoking as a reaction to stress, and work-related stressors were all consistently associated with increased intensity of

**TABLE I.** Analysis Sample Characteristics and Key Model Variables<sup>a</sup> ( $N = 4,748$ ).

Characteristics	<i>N</i> <sup>b</sup>	%
Gender		
Male	3,528	89.8
Female	404	10.1
Race/ethnicity		
White	2,601	55.0
Black	364	7.7
Hispanic	540	11.4
Other <sup>c</sup>	1,223	25.9
Education		
High school diploma or less	2,005	42.4
Some college	1,719	36.4
College degree or higher	176	3.7
Military rank		
Enlisted	3,903	98.5
Officer	60	1.5
Military service branch		
Army	1,428	30.2
Navy	930	19.7
Marine Corps	1,635	34.6
Air Force	735	15.6
Lifetime combat deployment		
Yes	2,526	56.6
No	1,936	43.4
Smoking initiation during military service		
Yes	1,921	41.0
No	2,771	59.0
Supervisor smoking		
Yes	3,439	78.0
No	969	22.0
Smoking intensity		
Light (10 or fewer cigarettes per day)	2,198	46.5
Moderate (11–20 cigarettes per day)	1,982	42.0
Heavy (21 or more cigarettes per day)	548	11.5
Nicotine dependence		
None	1,659	39.8
Low	1,333	29.3
Moderate	1,263	26.6
High	206	4.3
	Mean	SD
Problem drinking (AUDIT)	10.05	7.01
Impulsivity	1.32	0.85
Age of cigarette initiation	16.67	3.62
Number of tobacco outlets makes it easy to smoke	3.35	1.19
Smoking as part of being in the military	2.48	1.22
Smoking to fit in with unit	0.32	0.71
Peer use (factor score)	0.09	0.16
Smoking for stress management (factor score)	0.19	0.34
Work stress (factor score)	0.06	0.55

SD, standard deviation.

<sup>a</sup>See item definitions and score ranges in Methods section.

<sup>b</sup>Variable-specific total *N*s may not equal total sample size because of missing data.

<sup>c</sup>Includes missing responses and multiple races or ethnicities.

smoking. Impulsivity was not associated with moderate intensity of smoking ( $b = 0.07$  [0.05], not significant) but was a risk factor for high-intensity smoking ( $b = 0.17$  [0.08],  $p < 0.05$ ). Ease of purchasing tobacco at installations was not

associated with smoking at the highest level ( $b = -0.07$  [0.05], not significant) compared with lower levels. It was, however, negatively associated with smoking at moderate or higher amounts ( $b = -0.08$  [0.03],  $p < 0.05$ ) (Table II).

Table III presents the findings for nicotine dependence and contrasts (a) not dependent vs. low, moderate, or high dependence, (b) not dependent or low dependence vs. moderate or high dependence, and (c) not dependent, low, or moderate dependence vs. high dependence. More active coping, Hispanic ethnicity, and older age of cigarette initiation were related to lower levels of nicotine dependence at each level of this outcome. Regression estimates for coping and initiation were comparable across each level of dependence, suggesting a consistent impact, whereas the coefficients for Hispanic increased at higher levels of dependence, suggesting a greater impact of ethnicity on higher dependence. Female gender and other race/ethnicity were associated with less likelihood of dependence at lower levels but not at the highest level of dependence (Table III).

Greater nicotine dependence across each level of dependence was related to being in the Army, smoking to fit in with one's unit, and smoking as a reaction to stress. Of these, being in the Army and smoking to fit in were roughly equivalent across increments of dependence, whereas the impact of smoking in reaction to stress attenuated with higher levels of dependence. Impulsivity, smoking as a reaction

to stress, and being in the Marine Corps were all associated with greater likelihood of lower levels of dependence but not the highest level. Members of the Navy were at risk for greater dependence only at the lowest level ( $b = 0.27$  [0.13],  $p < 0.05$ ). Some factors showed inconsistency associated with dependence across the different levels of the outcome. Work-related stress was a significant risk for low and high dependence ( $b = 0.20$  [0.08],  $p < 0.05$ ;  $b = 0.47$  [0.17],  $p < 0.01$ ) but not for moderate dependence ( $b = 0.13$  [0.08], not significant). In contrast, AUDIT score and social support were significantly associated only with likelihood of dependence at the moderate threshold (AUDIT:  $b = 0.02$  [0.01],  $p < 0.01$ ); social support ( $b = -0.19$  [0.09],  $p < 0.05$ ). Perceiving smoking as part of being in the military was positively associated with the highest level of dependence ( $b = 0.18$  [0.08],  $p < 0.05$ ).

**DISCUSSION**

This study used an SE framework comprising individual, interpersonal, and unit/organizational constructs to better understand factors influencing cigarette smoking among active duty military personnel. Findings confirmed that multiple levels of influences were associated with greater smoking intensity and nicotine dependence. The highest levels of both intensity of smoking and nicotine dependence were associated with

**TABLE II.** Model Results, Smoking Intensity.

Effect	Light vs. Moderate and Heavy Estimate (SE)	Light and Moderate vs. Heavy Estimate (SE)
Active coping	-0.53 (0.11)***	-0.6 (0.15)***
Social support	-0.08 (0.08)	-0.17 (0.12)
Male	ref	ref
Female	-0.90 (0.13)***	-0.78 (0.25)**
White	ref	ref
Black	-0.96 (0.15)***	-0.72 (0.28)**
Hispanic	-1.17 (0.12)***	-0.59 (0.2)**
Other <sup>d</sup>	-0.70 (0.12)***	-0.71 (0.22)***
Problem drinking	0.01 (0.01)	0.00 (0.01)
Impulsivity	0.07 (0.05)	0.17 (0.08)*
Lifetime combat deployment	0.27 (0.08)**	0.05 (0.12)
Age of smoking initiation	-0.08 (0.01)***	-0.11 (0.02)***
Smoking initiation during military service	-0.16 (0.09)	-0.06 (0.14)
Supervisor smoking	-0.04 (0.08)	-0.07 (0.12)
Number of tobacco outlets makes it easy to smoke	-0.08 (0.03)*	-0.07 (0.05)
Smoking as part of being in the military	-0.02 (0.03)	0.03 (0.05)
Smoking to fit in with unit	0.20 (0.07)**	0.44 (0.08)***
Army	0.31 (0.14)*	0.36 (0.18)*
Navy	0.10 (0.14)	0.20 (0.2)
Marine Corps	-0.11 (0.15)	-0.29 (0.21)
Air Force	ref	ref
Peer use	0.20 (0.34)	-0.39 (0.53)
Smoking as stress management	1.26 (0.16)***	0.98 (0.26)***
Work stress	0.19 (0.08)*	0.38 (0.11)***

SE, standard error.

<sup>d</sup>Includes missing responses and multiple races or ethnicities.

\* $p < 0.05$ . \*\* $p < 0.01$ . \*\*\* $p < 0.001$ .

**TABLE III.** Model Results, Nicotine Dependence.

Effect	None vs. Low/Moderate/High Estimate (SE)	None/Low vs. Moderate/High Estimate (SE)	None/Low/Moderate vs. High Estimate (SE)
Active coping	-0.51 (0.11)***	-0.55 (0.11)***	-0.54 (0.22)*
Social support	-0.1 (0.09)	-0.19 (0.09)*	0.07 (0.18)
Male	ref	ref	ref
Female	-0.5 (0.13)***	-0.29 (0.15)	-0.4 (0.37)
White	ref	ref	ref
Black	-0.18 (0.15)	-0.05 (0.16)	-0.77 (0.44)
Hispanic	-0.62 (0.12)***	-0.76 (0.14)***	-0.82 (0.35)*
Other <sup>d</sup>	-0.41 (0.13)**	-0.45 (0.14)**	-0.4 (0.31)
Problem drinking	0.01 (0.01)	0.02 (0.01)**	0.02 (0.01)
Impulsivity	0.21 (0.05)***	0.25 (0.05)***	0.17 (0.12)
Lifetime combat deployment	0.21 (0.08)*	0.03 (0.09)	0.03 (0.18)
Age of cigarette initiation	-0.08 (0.01)***	-0.09 (0.01)***	-0.11 (0.03)***
Smoking initiation during military service	0.02 (0.09)	-0.07 (0.1)	0.1 (0.2)
Supervisor smoking	-0.11 (0.08)	-0.03 (0.09)	-0.17 (0.2)
Number of tobacco outlets makes it easy to smoke	-0.03 (0.04)	-0.06 (0.04)	-0.03 (0.08)
Smoking as part of being in the military	-0.01 (0.04)	0.05 (0.04)	0.18 (0.08)*
Smoking to fit in with unit	0.3 (0.07)***	0.38 (0.07)***	0.36 (0.11)***
Army	0.73 (0.13)***	0.81 (0.14)***	0.9 (0.3)**
Navy	0.27 (0.13)*	0.15 (0.15)	0.17 (0.35)
Marine Corps	0.28 (0.14)*	0.35 (0.15)*	-0.12 (0.35)
Air Force	ref	ref	ref
Peer use	-0.25 (0.35)	-0.13 (0.38)	-0.72 (0.83)
Smoking as stress management	1.42 (0.16)***	1.1 (0.18)***	0.91 (0.42)
Work stress	0.2 (0.08)*	0.13 (0.08)	0.47 (0.17)**

SE, standard error.

<sup>d</sup>Includes missing responses and multiple races or ethnicities.\* $p < 0.05$ . \*\* $p < 0.01$ . \*\*\* $p < 0.001$ .

individual and interpersonal influences (i.e., work stress and smoking as a stress reaction). Individual, unit/organizational, and protective influences were important for separating types of smokers. A lack of active coping skills, having ever been combat deployed, initiating cigarette use at a younger age, smoking to fit in, and access to cigarettes at one's installation were all important for separating low-intensity smokers from higher levels. For nicotine dependence, impulsivity and alcohol use added to the influence from the intensity measures (i.e., lack of coping, combat deployment, age of initiation, smoking to fit in, smoking as a reaction to stress, and access to cigarettes) to separate low-dependence individuals from those with higher dependence levels.

At the individual level, we found that male Army personnel had the highest levels of risk for heavy smoking and the greatest likelihood of high nicotine dependence and may potentially be at higher risk for negative performance outcomes. It is well documented that smoking is associated with lower levels of physical fitness, less mental sharpness, and increased risk of injury.<sup>2,32,33</sup> Regarding interpersonal influences, peer cigarette use and supervisor smoking behavior did not affect intensity or dependence after controlling for other variables. Interestingly, previous studies have shown that military personnel who report having a supervisor or training

instructor who smokes may be more likely to also smoke cigarettes.<sup>15,34</sup> Research has also demonstrated the influence of military peers on smoking behaviors.<sup>32,35,36</sup> The fact that these interpersonal influences were not significant speaks to the utility of using a broader ecological framework to parse out significant influences on smoking outcomes. At the unit/organizational level, our analyses suggest that an individual's desire to fit in with his or her military unit may be a stronger influence on smoking outcomes than peer use. This is in contrast to research among adolescents that showed that exposure to smokers was a strong predictor of established smoking vs. cigarette experimentation.<sup>37</sup> Among college students, rebelliousness and the belief that peers approved of smoking predicted the progression from experimentation to a higher level of smoking.<sup>38</sup> Thus, the influences of peers and role models on cigarette smoking among military personnel deserves further attention.

Our findings provide a more holistic perspective for examining influences on smoking intensity and nicotine dependence beyond those gleaned from separate levels alone. The ultimate purpose of a health behavior model is to inform the development of comprehensive interventions that can systematically identify and target mechanisms of behavior change. Such change is expected to be maximized when environments and policies support healthy choices, when social norms and social support for healthy choices are strong, and when

individuals are motivated and educated to make those choices.<sup>21</sup> Specifically, an SE model acknowledges that individuals interact with various environmental and social levels to influence health behaviors,<sup>21</sup> and on smoking in civilian populations.<sup>39,40</sup>

In addition to identifying multilevel influences of health behaviors, SE models help pinpoint opportunities for intervention. Interventions using the SE model might include a combination of strategies to influence change at different levels.<sup>41</sup> Previous work indicates that smoking interventions typically focus on intra- and interpersonal influences,<sup>42</sup> although individuals may interact with other community and organizational influences to contribute to outcomes. With this in mind, the current analyses suggest easy access to cigarettes and pressure to fit in as points for intervention, in addition to high stress and lack of active coping skills. Evidence-based strategies might include regulations concerning more smoke-free zones<sup>43-45</sup> and increased cigarette prices<sup>46,47</sup>; counter advertising, mass media campaigns, and social marketing, especially those geared to young adults,<sup>48-50</sup> to influence social norms<sup>51</sup>; and skills-development workshops to address stress and encourage seeking social support.<sup>52,53</sup>

The present study's findings should be viewed in light of some limitations and strengths. First, although the present survey obtained a response rate of 75%, there is still a non-negligible potential for response bias. The estimates cited here may underestimate the true prevalence of cigarette smoking and associated outcomes if those who were more likely to smoke were less likely to take the survey. Second, the study's findings are based on self-reported data and are only as valid as participants are truthful. Thus, if participants were reluctant to report how often they smoked, our estimates of smoking intensity and dependence would underreport the true prevalence. Another measurement limitation is that some indicators of SE model constructs were not ideal because the original survey was not designed with the SE model in mind. For example, our measures of organizational influences were based on participants' perceptions of the influences rather than objective indicators of organizational influences. Finally, the dataset did not include other psychological measures besides stress and impulsivity, such as suicide, anxiety, or depression since they have been linked to smoking.<sup>54-59</sup>

Despite these limitations, the study has a number of important strengths. First, it was based on a large robust sample comprising participants from all Department of Defense Services stationed at key military installations both in the continental United States and overseas. Additionally, participants were given assurances that their information would be kept private and confidential; self-report validity studies suggest that under these circumstances, most people are truthful in their responses.<sup>60,61</sup> Finally, participants were sampled as military units, which offered ecological validity to the social and psychological influences they experience in military life regarding tobacco use.

Reducing tobacco use in the military will require coordinated, multilevel interventions that address the numerous determinants of use. Drawing on the SE model to address the health of our military population can be useful to the strategic alignment of policy and services across the continuum of health care needs and may be more cost-effective than focusing solely on behavioral and pharmaceutical interventions at the individual level.<sup>62</sup> Multilevel policy and environmental interventions can establish incentives that may sustain behavior changes, which in turn may help to solve the problem that it is difficult to maintain change with individually directed interventions. The military needs to create an environment and supporting policies that make it convenient, attractive, and economical to reduce cigarette smoking. The challenge is to be creative and persistent in using an SE model to generate evidence on the roles of behavioral influences at multiple levels and to translate that evidence into improved health.<sup>21</sup>

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