

## Original Investigation

# Cigarette smoking and subsequent hospitalization in a cohort of young U.S. Navy female recruits

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## Abstract

**Introduction:** Tobacco use is of particular concern to the U.S. Department of Defense because the military historically has had higher and heavier rates of tobacco use than civilians. Few prospective studies have examined the association of cigarette smoking with medical outcomes, particularly among initially healthy female military personnel.

**Methods:** This prospective cohort study followed over 5,000 young U.S. Navy female recruits varying in their smoking status at entry into the Navy and collected their subsequent hospitalization data (i.e., International Classification of Diseases, Ninth Revision codes) for up to 7–8 years of service.

**Results:** Results indicated that after adjusting for differences in time at risk and sociodemographic variables, daily smokers (compared with never and other smokers) had higher rates of hospitalization for any reason and for musculoskeletal conditions. Daily smokers also had higher rates than never- and other smokers for non-pregnancy-related hospitalizations and for mental disorders, although only the daily/other differences reached statistical significance. Daily smokers' average number of days hospitalized was significantly longer than that of never- and other smokers.

**Discussion:** Results suggest that young women do not have to wait decades to experience the harmful effects of smoking. A recent history of cigarette smoking is an important determinant of hospitalization risk for even young healthy women in the U.S. Navy.

## Introduction

Our recent prospective study of young female Navy recruits found a consistent pattern of results in which, compared with never-smokers, daily cigarette smokers at entry into the Navy

were subsequently more likely to have poorer outcomes on a wide variety of Navy career indicators, such as shorter term enlistments, earlier attrition, more less-than-honorable discharges, more misconduct discharges, more demotions and desertions, lower final pay grade, and less likelihood of reenlistment (Conway, Woodruff, & Hervig, 2007). Additional previous research indicates that cigarette smoking in the military has adverse effects on performance, physical fitness, and premature attrition from service (Bahrke, Baur, Poland, & Connors, 1988; Blake & Parker, 1991; Conway & Cronan, 1988a, 1988b, 1992; Klesges, Haddock, Chang, Talcott, & Lando, 2001; Larson & Kewley, 2000; Zadoo, Fengler, & Catterson, 1993).

Tobacco use is of particular concern to the U.S. Department of Defense because the military historically has had higher prevalence and heavier use rates of tobacco use than civilians (Bray et al., 2003; Conway, 1998; Woodruff, Conway, Edwards, & Elder, 1999). Although smoking in the military decreased dramatically from 1980 to 2005, past 30-day smoking between active duty military men and women remains significantly higher than that among their civilian counterparts (32% vs. 24%, respectively; Bray et al., 2006). Furthermore, military rates of smoking continue to far exceed the *Healthy People 2010* objective of 12% (U.S. Department of Health and Human Services [USDHHS], 2000). Additional concerns arise when considering high rates of smoking persist even after discharge from military service (Feigelman, 1994; Klevens et al., 1995).

The association of smoking with medical outcomes among military personnel has been examined to some degree. Altarac et al. (2000) reported a positive association between cigarette smoking just prior to entering basic training and physical injuries in male and female Army personnel during basic training. Lincoln, Smith, Amoroso, and Bell (2003) reported that smoking was associated with long-term disability following an initial musculoskeletal hospitalization among generally young Army personnel. Few studies have examined smoking as a predictor of hospitalization specifically or followed healthy young women in military service. One of the few was a study of young healthy

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active duty Army personnel in which cigarette smoking accounted for a substantial fraction of hospitalizations and lost workdays, particularly among men (Robbins, Fonseca, Chao, Bell, & Amoroso, 2000).

This present prospective cohort study was designed to follow young U.S. Navy female recruits varying in their smoking status at entry into the Navy. By matching entry smoking data on female recruits with their subsequent hospitalization data while in the Navy, it was possible to investigate whether women's smoking history prior to entering the Navy was a prospective predictor of hospitalization over a period of up to 7–8 years of service.

## Methods

### Procedures and sources of data

During their first week of in-processing at the Navy Recruit Training Command, Great Lakes, all female recruits entering the U.S. Navy between March 1996 and 1997 (12 consecutive months) were asked to complete machine-scannable surveys assessing detailed information about their smoking behavior "just prior to entering the Navy." A sample of 5,503 women completed the survey—93% of the overall female recruit population during that 1-year period. The 7% who did not complete the smoking survey failed primarily because of scheduling conflicts and introduced no sampling bias (see Conway et al., 2004, 2007, for more detail about the sample and procedures).

On 23 June 2005 (7–8 years after the smoking survey was completed), participants' smoking data were linked to a second dataset, the Career History Archival Medical and Personnel System (CHAMPS). CHAMPS is a comprehensive database that provides individual-level, historical, medical, and career information for active duty military personnel (see Gunderson, Garland, Miller, & Gorham, 2005, for a detailed description of CHAMPS). CHAMPS does not include information for service members after discharged from the military. All but 16 recruits were successfully matched to CHAMPS, and inpatient hospitalization information was extracted. A series of steps using dummy ID codes were used to link the two datasets, thereby ensuring that personal identifying information never appeared in the merged data file and protecting participants' confidentiality. All procedures used in this research were approved by the San Diego State University and Naval Health Research Center, San Diego, California, Institutional Review Boards.

### Measures

**Smoking survey variables.** Smoking measures were based on those used by other researchers investigating smoking between Navy and young civilian populations (Becker et al., 1989; Bray, Marsden, & Peterson, 1991; Stanton, Lowe, & Gillespie, 1996; Stanton, McClelland, Elwood, Ferry, & Silva, 1996). The primary smoking variable for this study was a three-category measure based on two separate items asking individuals to report on the frequency of smoking (i.e., not applicable/don't smoke, some days, or everyday) and their perceptions of the type of smoker they are (i.e., never-smoker, experimented, occasional, daily, or former). Our previous work suggests that self-reported smoking status varies depending on the wording of the item. Therefore, we used these two items (one behavioral and

one based on perceptions) to derive smoking status just prior to entering recruit training. The resulting three categories were (a) never-smoker, (b) other smoker, and (c) daily smoker. Never- and daily smokers were individuals who consistently reported their status on both items as either never smoking or daily smoking. Individuals reporting that they were experimenters, occasional smokers, some-day smokers, or former smokers and the few who were inconsistent in their reports on the two items were categorized as other smokers. The rationale for inclusion of former and experimental smokers as other smokers was based on previous studies of Navy personnel that suggested those individuals may be at risk for smoking regularly after joining the Navy (Cronan, Conway, & Kaszas, 1991).

### CHAMPS hospitalization, time in service, and sociodemographic variables.

Information about all hospitalizations during the individual's military service came from CHAMPS inpatient records. Each hospitalization had up to eight diagnoses, which were coded by members of hospital staff using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM), the major coding system utilized for coding of inpatient diagnoses (USDHHS, 1989). For the present study, the primary diagnosis for each hospitalization was grouped into 1 of 17 broad disease and injury categories used by the ICD-9-CM, including infectious and parasitic diseases (ICD-9 codes 001–139.99); neoplasms (codes 140.00–239.99); endocrine, nutritional, and metabolic diseases and immunity disorders (codes 240.00–279.99); diseases of the blood and blood-forming organs (codes 280.00–289.99); mental disorders (codes 290.00–319.99); diseases of the nervous system and sense organs (codes 320.00–389.99); diseases of the circulatory system (codes 390.00–459.99); diseases of the respiratory system (codes 460.00–519.99); diseases of the digestive system (codes 520.00–579.99); diseases of the genitourinary system (codes 580.00–629.99); pregnancy, childbirth, and puerperium (codes 630.00–679.99); diseases of the skin and subcutaneous tissue (codes 680.00–709.99); diseases of the musculoskeletal system and connective tissue (codes 710.00–739.99); congenital anomalies (codes 740.00–759.99); certain conditions originating in the perinatal period (codes 760.00–779.99); ill-defined conditions (codes 780.00–799.99); and injury and poisoning (codes 800.00–999.99).

From this information, we computed counts of the (a) number of hospitalizations (i.e., hospitalizations for any cause); (b) number of hospitalizations excluding pregnancy; (c) number of hospitalizations in each of the 17 broad diagnostic categories; and (d) dichotomous variables (yes/no), indicating whether or not an individual was hospitalized for any cause, for pregnancy-related causes, and for any cause excluding pregnancy. In addition, the total number of days hospitalized was computed across all hospitalizations as a measure of the individual's lost workdays.

Time in Navy service, an estimate of the actual time at risk, a likely confounder with other time-dependent outcomes (such as occurrence of hospitalization over time), was calculated from the individual's entry date into the Navy and either their discharge date or, if not yet discharged, the date of the follow-up data extraction. Demographic and service-specific variables extracted from CHAMPS included (a) age, computed from birth date and the date of the smoking survey; (b) education level (less than high school, exactly high school, and greater than high school); (c) racial/ethnic group (White non-Hispanic, Black, Hispanic, and other); and (d) regular versus reserve enlistment status.

## Analytical approach

**Determination of covariates/confounders.** Previous research with this study sample found that never-smokers, other smokers, and daily smokers were virtually the same with regard to age, although they differed significantly on five sociodemographic and enlistment-specific variables (Conway et al., 2007). A slightly higher percentage of daily smokers had less than a high school education (9%) compared with the other two groups (4%–5%). Smoking groups also differed with regard to race/ethnicity. Daily smokers were predominately White non-Hispanic (80%), whereas never-smokers were near equally comprised White non-Hispanics (41%) and Blacks (39%). Time in Navy service (i.e., time at risk in the present study) varied by smoking status. Never-smokers were in the Navy the longest time (3.6 years on average,  $SD = 1.8$ ), daily smokers the shortest time (2.3 years,  $SD = 1.9$ ), and other smokers were intermediate (3.4 years,  $SD = 1.9$ ). Never-smokers typically had a significantly longer term-of-enlistment commitment and a different type of enlistment than did daily smokers. That is, compared with daily smokers, never-smokers were more likely to have an 8-year enlistment commitment and to be reservists (vs. regular enlistment). Because of these differences documented as significantly related to smoking in the previous publication, these five variables were considered as potential confounding variables. However, enlistment term and regular/reserve enlistment type were very highly correlated ( $r = .88$ ), and therefore, regular/reserve was used as a variable to control for in analyses, along with time in service, education level, and race/ethnicity.

**Statistical analyses.** Estimated marginal means from binary logistic and Poisson regression were used to assess the percent of individuals within each smoking group who were hospitalized as well as their mean number days hospitalized. Covariates in these initial analyses were time in service, education, race/ethnicity, and regular/reserve status. Poisson regression was used for most of the analyses because it is an appropriate technique when the dependent variable is a count of rare events (such as number of hospitalizations) and is also appropriate for rate data where the rate is a count of events occurring to an individual divided by some measure of that individual's observation time (Cameron & Trivedi, 1998). To assess the association of smoking with hospitalization rates, separate multivariate Poisson regression was used to examine the relationship between smoking status and rates of hospitalization for all causes combined, for all causes combined other than pregnancy, and for the 17 diagnostic categories. Differences in observation time were handled by including the natural log of time in service as an offset variable; education, race/ethnicity, and regular/reserve status were entered as control factors. Using daily smokers as the reference group, adjusted rate ratios (RRs) and associated two-sided 95% CIs were computed comparing never-smokers with daily smokers and other smokers with daily smokers. Estimated marginal means from Poisson regression were used to obtain adjusted incidence rates to describe the top reasons for hospitalization overall and to further describe the statistically significant smoking/hospitalization associations.

## Results

### Characteristics of the sample

The cohort included 5,503 female recruits representing 18,415 person years of follow-up. As previously reported for this sample

(Conway et al., 2007), the mean age at entry into the Navy was 19.7 years ( $SD = 2.75$ ), with 75% being 20 years of age or younger. The sample race/ethnicity distribution was 58% White non-Hispanic, 23% Black non-Hispanic, 12% Hispanic, and 7% other. Most recruits had at least a high school diploma (94%), although 6% had less than a high school education. The average time spent in the Navy at the follow-up assessment was 3.4 years ( $SD = 1.9$ ), with a range of 0.01–8.3 years. At entry into the Navy, never-smokers comprised 45% of the sample ( $n = 2,438$ ), 28% were other smokers ( $n = 1,523$ ), and 27% were daily smokers ( $n = 1,503$ ).

### Adjusted percent hospitalized and days hospitalized by smoking status

These data included a total of 2,753 hospitalizations among 1,914 individuals over the follow-up timeframe: 47% of the total hospitalizations ( $n = 1,283$ ) were among never-smokers, 26% ( $n = 720$ ) were among other smokers, and 27% ( $n = 750$ ) were among daily smokers. Overall, one third (33%) of female recruits were hospitalized at least once over the course of the follow-up period. As shown in Table 1, the percent of never-, other, and daily smokers who were hospitalized at least once for any reason did not vary significantly after adjusting for time in service, education, race/ethnicity, and regular/reserve status. Pregnancy was the most common reason for hospitalization in all smoking groups—21% of female recruits had at least one pregnancy-related hospitalization, a percent that did not vary by smoking status. The percent hospitalized with non-pregnancy-related diagnoses (13% overall) did not vary significantly by smoking group. Among all those admitted, the mean number of days hospitalized was 5.3 days, with daily smokers having significantly more days (5.7 days) than never- and other smokers (5.1–5.2 days).

### Top reasons for hospitalization overall

The overall adjusted incidence rate for hospitalization due to all causes was 107.4 per 1,000 person years ( $SE = 4.88$ ). For all causes combined excluding pregnancy, the adjusted incidence rate was 41.3 per 1,000 ( $SE = 2.98$ ). Regarding the specific broad diagnostic categories, pregnancy, mental disorders, genitourinary system conditions, digestive system conditions, and poisoning/injuries were the top five diagnoses. Pregnancy-related rates were by far the highest, with 65 hospital admissions per 1,000 person years ( $SE = 3.83$ ). Mental disorders were the second highest reason for hospitalization, with 12.2 hospitalizations per 1,000 person years ( $SE = 1.61$ ). Genitourinary conditions, digestive system conditions, and poisoning and injuries occurred at rates of 4.4 ( $SE = 0.96$ ), 4.2 ( $SE = 0.94$ ), and 3.4 ( $SE = 0.84$ ), respectively.

### Hospitalization RRs by smoking status

Poisson regression analyses were conducted to obtain adjusted RRs by smoking group for hospitalizations for any reason, for hospitalizations excluding pregnancy-related conditions, and for the 17 broad diagnostic categories, controlling for education level, race/ethnicity, and regular/reserve status. As noted above, time in service was included as an offset variable to reflect the variable time at risk, and daily smokers were the reference group. As shown in Table 2, never- and other smokers were at lower risk for hospitalizations due to any cause than daily smokers. Never- and other smokers were also at markedly

**Table 1. Estimated marginal means for percent hospitalized and days hospitalized by smoking group**

Hospitalization variable	Adjusted percent (SE)				For Wald	Group difference
	Overall (n = 5,464) <sup>a</sup>	Never-smoker (n = 2,438)	Other smoker (n = 1,523)	Daily smoker (n = 1,503)		
Percent hospitalized for any cause <sup>b</sup>	33 (1.5)	33 (1.6)	32 (1.8)	33 (1.9)	0.91	—
Percent hospitalized for pregnancy-related conditions <sup>b</sup>	21 (1.2)	20 (1.4)	21 (1.6)	21 (1.7)	1.49	—
Percent hospitalized excluding pregnancy <sup>b</sup>	13 (1.0)	14 (1.2)	12 (1.2)	13 (1.3)	4.04	—
Mean number of days hospitalized among those admitted <sup>c</sup>	5.3 (0.124)	5.2 (0.129)	5.1 (0.144)	5.7 (0.164)	18.84***	<sup>d</sup>

Note. <sup>a</sup>Thirty-nine individuals had missing smoking data.

<sup>b</sup>Binary logistic regression with estimates adjusted for the covariates of time in service, education, race/ethnicity, and regular/reserve status.

<sup>c</sup>Poisson regression with estimates adjusted for the covariates of time in service, education, race/ethnicity, and regular/reserve status (n = 1,887).

<sup>d</sup>Daily smokers significantly different from never- and other smokers.

\*\*\*p ≤ .001.

lower risk than daily smokers for musculoskeletal-type admissions. Never- and other smokers were also considerably less likely than daily smokers to be hospitalized for nonpregnancy causes combined and for mental disorders. However, only the difference between other and daily smokers reached statistical significance. Smoking groups did not differ significantly on adjusted RRs for most diagnoses, including pregnancy, and other relatively common diagnoses of the genitourinary system, di-

gestive system, and poisoning and injuries. There were no diagnoses for perinatal conditions.

### Adjusted incidence rates for significant smoking/hospitalization associations

To further aid interpretation of statistically significant RRs, we computed adjusted incidence rates for those diagnoses found to

**Table 2. RRs from Poisson multiple regression examining hospitalization rates by smoking status for principle diagnosis categories**

Diagnosis	Adjusted RR (95% CI)			Wald statistic	Group difference
	Never-smoker (n = 2,438)	Other smoker (n = 1,523)	Daily smoker <sup>a</sup> (n = 1,503)		
Any cause	0.90 (0.81–0.99)	0.87 (0.78–0.96)	1.00	7.77*	<sup>b</sup>
Any cause excluding pregnancy	0.89 (0.76–1.03)	0.80 (0.68–0.94)	1.00	7.42*	<sup>c</sup>
Pregnancy related	0.92 (0.80–1.04)	0.92 (0.80–1.05)	1.00	2.22	—
Mental disorders	0.80 (0.61–1.04)	0.70 (0.53–0.94)	1.00	5.95*	<sup>c</sup>
Genitourinary system	1.10 (0.70–1.72)	1.02 (0.64–1.65)	1.00	0.19	—
Digestive system	1.06 (0.66–1.68)	0.61 (0.35–1.06)	1.00	4.67	—
Poisoning and injury	0.87 (0.53–1.42)	0.77 (0.45–1.32)	1.00	0.91	—
Musculoskeletal system	0.35 (0.19–0.63)	0.34 (0.18–0.66)	1.00	16.40**	<sup>b</sup>
Respiratory system	1.17 (0.58–2.36)	1.15 (0.55–2.41)	1.00	0.21	—
Ill-defined conditions	1.21 (0.60–2.49)	0.65 (0.28–1.55)	1.00	2.46	—
Infectious conditions	0.68 (0.28–1.59)	0.95 (0.41–2.23)	1.00	1.05	—
Skin conditions	0.84 (0.32–2.24)	1.00 (0.38–2.64)	1.00	0.16	—
Nervous system	1.05 (0.29–3.76)	2.84 (0.91–8.87)	1.00	5.80	—
Neoplasms	5.13 (0.65–40.83)	5.98 (0.74–48.32)	1.00	2.81	—
Endocrine system	1.79 (0.55–5.86)	0.22 (0.03–2.00)	1.00	4.41	—
Congenital anomalies	0.67 (0.12–3.66)	0.98 (0.19–4.96)	1.00	0.27	—
Blood conditions	1.49 (0.13–17.80)	3.11 (0.32–30.14)	1.00	0.63	—
Circulatory system	3.12 (0.33–30.05)	2.22 (0.20–24.57)	1.00	0.98	—
Perinatal conditions	—	—	—	—	—

Note. RRs adjusted for log-transformed time in service (offset), education, race/ethnicity, and regular/reserve status. RR = rate ratio.

<sup>a</sup>Reference category.

<sup>b</sup>Daily smokers significantly different from never- and other smokers.

<sup>c</sup>Daily smokers significantly different from other smokers.

\*p ≤ .05; \*\*p ≤ .001.

**Table 3. Adjusted incidence rates for total hospitalizations and for principal diagnosis categories overall and by smoking group**

Diagnosis	Rate per 1,000 person years				Group difference
	Overall ( <i>n</i> = 5,464)	Never-smoker ( <i>n</i> = 2,438)	Other smoker ( <i>n</i> = 1,523)	Daily smoker ( <i>n</i> = 1,503)	
Any cause	107.4	105.2	100.9	116.7	<sup>a</sup>
Any cause excluding pregnancy	41.3	41.2	36.9	46.5	<sup>b</sup>
Mental disorders	12.2	11.8	10.4	14.8	<sup>b</sup>
Musculoskeletal conditions	2.5	1.7	1.7	5.0	<sup>a</sup>

Note. Rates adjusted for log-transformed time in service (offset), education, race/ethnicity, and regular/reserve status.

<sup>a</sup>Daily smokers significantly different from other two categories.

<sup>b</sup>Daily smokers significantly different from other smokers.

have statistically different RRs by smoking group. As shown in Table 3, for hospitalization for any cause, daily smokers had a rate of 116.7 per 1,000 person years compared with ~101 and 105 per 1,000 person years for other and never-smokers, respectively. Daily smokers' rate of hospitalizations for musculoskeletal conditions was 5.0 per 1,000 person years, almost three times the rate of never- and other smokers. Other smokers' hospitalization rate for all causes excluding pregnancy was about 37 compared with 46.5 for daily smokers. Mental health hospitalization rates were about 15 and 10 per 1,000 person years for daily and other smokers, respectively.

## Discussion

This study found that even among a cohort of young healthy Navy female recruits (average age of 19 years old at baseline), cigarette smoking was a prospective predictor of hospitalization. Taking into account differences in time at risk, education level, race/ethnicity, and regular versus reserve enlistment status, daily smokers (compared with never- and other smokers) had higher rates of hospitalizations for any reason and for musculoskeletal conditions. Daily smokers also had higher rates than never- and other smokers for non-pregnancy-related hospitalizations and for mental disorders, although only the daily/other differences reached statistical significance. In addition, daily smokers' average number of days hospitalized was significantly longer than that of never- and other smokers by about half of a day. It is interesting to note that the percent of women hospitalized did not vary by smoking group, although rates did, underscoring the impact of multiple hospitalizations for some individuals.

These results are similar in some respects to a retrospective cohort study by Robbins et al. (2000) of a large sample of active duty Army women in which cigarette smoking independently accounted for significant amounts of hospitalization and lost work-days, even over a relatively short follow-up period. For example, Army women who currently smoked had a 25% greater risk of hospitalization for conditions not related to injury or pregnancy relative to those who never smoked, after controlling for other health risk factors. Former smokers were intermediate, being at 13% greater risk for hospitalization for this broad range of conditions. In addition, current smokers (and to some degree, former smokers) were at increased risk of more days in the hospital (Robbins et al.). An important distinction between the Army

study and the present one is that the Army study analyzed a large representative cross-section of the Army population (mean age of 29 years at baseline), whereas the present study focused on new Navy recruits (mean age of 19 years at baseline). Given these methodological differences, the consistency of smoking/hospitalization associations is noteworthy.

The finding that female smokers are at greater risk for musculoskeletal hospitalization is not surprising, insofar as civilian studies (Hopper & Seeman, 1994) as well as other military studies (Altarac et al., 2000; Bell, Mangione, Hemenway, Amoroso, & Jones, 2000; Friedl, Nuovo, Patience, & Dettori, 1992; Jones et al., 1993; Lincoln et al., 2003; Robbins et al., 2000) have implicated smoking as a risk factor for musculoskeletal injury. Furthermore, after adjusting for psychosocial and occupational factors, Lincoln et al. found smoking to be an independent risk factor for disability following some types of musculoskeletal injury among young Army personnel. Although the biological mechanisms are not clearly understood, the effects of smoking may include cellular oxygen deficiency, demineralization of bone, immune suppression, and delayed supply of nutrients to the injury, thereby interrupting the healing process. It may be that in the present study, smokers and nonsmokers had the same incidence of initial injury; yet because smoking adversely affects the injury repair process, smokers were at risk for hospitalization for the injury. The smoking/musculoskeletal injury association is of concern because of the high frequency, cost, negative impact on military readiness, and high likelihood of resulting disability from these types of injuries (Feuerstein, Berkowitz, & Peck, 1997; Lincoln et al.).

Morbidity due to mental health problems was considerable in this cohort of young women (particularly among those with a history of smoking). Follow-on analyses of specific ICD-9 codes within the broad mental health category showed that brief depressive reaction was the top diagnosis among those with a mental health hospitalization. The association between regular smoking and mental health morbidity, particularly depression, is well documented (Breslau, Peterson, Schultz, Chilcoat, & Andreski, 1998; Covey, Glassman, & Stetner, 1998; Klungsoyr, Nygard, Sorensen, & Sandanger, 2006; Pasco et al., 2008). Some studies indicate that smoking precedes depression (Klungsoyr et al.; Steuber & Danner, 2006), and other studies suggest that depression precedes smoking (Breslau, Kilbey, & Andreski,

## Cigarette smoking and subsequent hospitalization in recruits

1993; Breslau et al., 1998). Other studies support a third explanation that depression and smoking have a common cause, such as genetic factors (Kendler, Neale, Heath, Eaves, & Kessler, 1993; Korhonen et al., 2007). The effectiveness of some norepinephrine and dopamine reuptake inhibitors, such as bupropion, for treating both depression and nicotine dependence suggests a common neurochemical mechanism (Foley, DeSanty, & Kast, 2006).

Standardized comparison with civilian hospitalization rates was not the purpose of the present study. In fact, military hospitalization rates are not directly comparable with civilian rates because of structural and organizational differences. Service members have ready access to free health care and unrestricted sick leave, and therefore, there are fewer potential barriers to hospitalization. In addition, the military may hospitalize an individual for a relatively minor condition that would typically not be a reason for civilian hospitalization because the service member needs care and may not have family nearby (Smith, Dannenberg, & Amoroso, 2000). Regardless, there were striking similarities between our findings and those from national databases. Pregnancy is clearly the most common reason for hospitalization between young civilian and military women, regardless of branch of service (Kozak, DeFrances, & Hall, 2006; Robbins et al., 2000). But it is also interesting to note that the top five reasons for hospitalizations for female recruits were the same as those for civilian women in the youngest age group (15–44 years) reported in national statistics (Kozak et al.). In 2004, pregnancy, mental disorders, genitourinary system disorders, poisoning and injuries, and digestive system problems were the top five consecutive broad diagnostic categories among civilian women based on data collected through the National Hospital Discharge Survey, and these were the same diagnoses in nearly the same order as seen for Navy women in the present study.

Our analyses indicated that “other” smokers (i.e., former smokers, experimenters, occasional smokers, and a small number of inconsistent reporters) were not at greater risk for hospitalization than never-smokers and, in fact, were at particularly low risk for hospitalizations for nonpregnancy and mental disorders conditions. The other smoker group was not a homogenous group and included a subgroup (12%) of former smokers. It may be that this group smoked so infrequently that they did not have any health consequences requiring hospitalization. Over 80% of the other smoker group reported that they did not intend to smoke after leaving recruit training command and if they followed through on that intention may have avoided subsequent illness/injury and hospitalization. It may be that other smokers (i.e., lighter and former smokers) took advantage of the smoke-free environment during recruit training to begin a process of behavioral changes that contributed to improved health and decreased likelihood of hospitalization. At least one other study of recruits reported an inconsistent dose–response relationship between levels of smoking and morbidity—female Army recruits with a history of heavy smoking were found to have lower risk of injury than lighter smokers (Altarc et al., 2000).

These results suggest that strategies are needed to decrease smoking and subsequent hospital admissions among young female service members. Even though military recruits are forced to abstain from tobacco use during basic training, most return

to their pretraining use pattern soon after leaving basic training (Haddock, Klesges, Talcott, Lando, & Stein, 1998; Haddock et al., 2000; Woodruff, Conway, & Edwards, 2000), and there is also the problem of beginning to smoke after joining the military (Bray et al., 2006; Chisick, Poindexter, & York, 1998; Ebbert et al., 2006). It has been suggested by many (including active duty service members themselves) that the military sends mixed messages about tobacco use by generally making it easily accessible and relatively inexpensive, while banning its use during basic training and espousing the importance of a smoke-free force (Forgas, Meyer, & Cohen, 1996; Nelson & Pederson, 2008; Nelson, Pederson, & Lewis, 2009). There have been attempts to dramatically change the culture of smoking and military service. A recent study commissioned by the Department of Veterans Affairs and the Pentagon and conducted by the Institute of Medicine recommended a complete ban on tobacco, including the end of tobacco sales on military bases and the banning of smoking even in combat settings. However, the complete ban has been rejected by the Department of Defense, citing morale issues.

Tobacco use is often cited by service members as useful for relaxing and coping with stress due to family separation, mission and occupational demands, and combat (Bray, Fairbank, & Marsden, 1999; Bray et al., 2006; Forgas et al., 1996). In addition, young service members, although knowledgeable about the ill effects of tobacco use, report that their youth affords some protection, and they may think about quitting later in life (Kenny, Quigley, & Regennitter, 1996; Nelson et al., 2009). Interventions that help military members deal with military-specific stressors are needed. Lincoln et al. (2003) have suggested that aggressive campaigns directed at issues that are of interest to young people, such as poor wound healing and impotence, might be more effective than focusing on longer term health outcomes.

Our analyses have a number of strengths. The prospective design of following new enlistees (ostensibly healthy) allowed us to measure true hospital incidence. The large group studied (nearly all women entering the Navy over a 1-year period) provided high statistical power and excellent representation of Navy female recruits. Sociodemographic data allowed us to control for confounding variables. Many recruits enlist for only 2–4 years; therefore, accurate data are needed to compute time at risk. Dates of discharge from military service were available; therefore, we were able to compute an exact time at risk for each individual. Because active duty personnel are unlikely to be hospitalized outside of the military system, we are confident that most hospitalizations were captured. Our data source may have not captured hospitalizations that occurred during deployment, but this number is likely very small. Finally, the use of multiple regression techniques to control for confounders, specifically the use of Poisson regression (vs. linear regression) for relatively rare outcome events, is a strength.

The analyses also have limitations. Smoking information was self-reported with no objective validation. The study data only included hospitalization experiences of women up until June of 2005 (an average of a 3.4-year follow-up). The women were still very young at the follow-up (23 years old on average), and therefore, many diagnoses, particularly chronic diseases, would not yet have developed. In addition, no data were available for hospitalizations after the woman was discharged from military service, and other utilization data, such as outpatient

visits, were not available. Smoking status at only one point in time—at entry into recruit training—was used as the risk factor/exposure measure for subsequent hospitalizations. We do not know for how long recruits continued to smoke after leaving recruit training (although we know that 89% of baseline daily smokers had returned to smoking 3 months after leaving training; Woodruff et al., 2000). Other risk factors, such as obesity, alcohol and drug use, low fitness levels, and psychosocial variables (e.g., maladjusted social behaviors, perceived stress), have been found to be more common in military smokers than in nonsmokers (Kao, Schneider, & Hoffmann, 2000; Lincoln et al., 2003). These variables were not included in the present study and may have contributed to daily smokers' greater risk of morbidity and subsequent hospitalization. Another limitation is that no information was available about medical conditions that may have existed prior to the woman entering the Navy.

Apart from the limitations, this study suggests that young women do not have to wait decades to experience the harmful effects of smoking. A recent history of cigarette smoking is an important determinant of hospitalization risk for even young healthy women in the U.S. Navy.

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## Declaration of Interests

None declared.

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## Cigarette smoking and subsequent hospitalization in recruits

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