

Award Number: W81XWH-04-1-0203

TITLE: Predicting Attrition, Performance, Reenlistment, and Hospitalizations from the Smoking History of Women Prior to Entering the Navy

PRINCIPAL INVESTIGATOR: Terry L. Conway, Ph.D.

CONTRACTING ORGANIZATION: San Diego State University Foundation
San Diego, CA 92182-1900

REPORT DATE: February 2006

TYPE OF REPORT: Final

PREPARED FOR: U.S. Army Medical Research and Materiel Command
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for Public Release;
Distribution Unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

1. REPORT DATE (DD-MM-YYYY) 01-02-2006			2. REPORT TYPE Final		3. DATES COVERED (From - To) 15 Jan 2004 - 14 Jan 2006	
4. TITLE AND SUBTITLE Predicting Attrition, Performance, Reenlistment, and Hospitalizations from the Smoking History of Women Prior to Entering the Navy					5a. CONTRACT NUMBER	
					5b. GRANT NUMBER W81XWH-04-1-0203	
					5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Terry L. Conway, Ph.D. E-Mail: tconway@mail.sdsu.edu					5d. PROJECT NUMBER	
					5e. TASK NUMBER	
					5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) San Diego State University Foundation San Diego, CA 92182-1900					8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5012					10. SPONSOR/MONITOR'S ACRONYM(S)	
					11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution Unlimited						
13. SUPPLEMENTARY NOTES						
14. ABSTRACT: This study of women sailors examined whether tobacco use prior to entering the Navy predicted subsequent career outcomes related to length of service, early attrition, misconduct, and hospitalizations over a possible 7-8 year follow-up. For almost 5,500 women entering the U.S. Navy between March 1996 - March 1997, who participated in Operation Stay Quit (OSQ) (USAMRMC Grant #DAMD17-95-1-5075), smoking history data were merged with personnel and medical data from the Career History Archival Medical and Personnel System (CHAMPS), a database maintained by the Naval Health Research Center, San Diego. A consistent pattern of results indicated that, compared to Never smokers, Daily smokers at entry into the Navy were subsequently more likely to have poorer outcomes on a wide variety of Navy career indicators (e.g., shorter-term enlistments, more early attrition, more less-than-honorable discharges, more misconduct discharges, more demotions and desertions, lower final paygrade, less likely recommended for reenlistment, and less likely to reenlist). The category of Other smokers (i.e., had smoked, but not daily at entry into the Navy) consistently fell between Never and Daily smokers on the career indicators. No consistent differences were found in the hospitalization data. Future research should evaluate the impact of smoking cessation intervention to help daily smokers become non-daily or former smokers prior to entering the Navy to determine whether this can improve subsequent career outcomes and help prevent or circumvent the high costs associated with lifestyle-related early attrition and poor job performance.						
15. SUBJECT TERMS Navy Women, Smoking, Prospective, Attrition, Career Outcomes, Hospitalizations						
16. SECURITY CLASSIFICATION OF:				17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON USAMRMC
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U	19b. TELEPHONE NUMBER (include area code)			
				UU	45	

Table of Contents

Cover.....	
SF 298.....	2
Introduction.....	4
Body.....	4
Key Research Accomplishments.....	19
Reportable Outcomes.....	20
Conclusions.....	20
References.....	22
Appendices.....	24

Introduction

This study focuses specifically on women sailors and whether their tobacco use prior to entering the Navy is predictive of subsequent career outcomes. We are testing the general predictions that smoking at entry into the Navy is related to attrition prior to completing the first term of enlistment, poorer performance evaluations and career advancement, more disciplinary problems, lower reenlistment, and more hospitalizations of various types. The sample includes almost 5,500 women entering the US Navy between March 1996 and March 1997. These women were participants in a study called “Operation Stay Quit” (OSQ), which was funded by the Defense Women's Health Research Program (DWHRP) through the US Army Medical Research and Materiel Command (Grant #DAMD17-95-1-5075, "Improving Navy Women's Health: Preventing Smoking Relapse After Recruit Training"). Detailed information on female recruits' smoking history was collected for the OSQ study. This dataset, representing nearly the complete population (i.e., 93%) of women recruits entering the Navy over this 1-year period during 1996-1997, provides a unique opportunity to examine *prospectively* the relationship between tobacco use prior to entering the Navy and subsequent career performance. Information on attrition and career performance has been obtained from the Career History Archival Medical and Personnel System (CHAMPS) database maintained by the Naval Health Research Center (NHRC), San Diego. After matching existing OSQ smoking data on almost 5,500 women recruits with their subsequent career performance and hospitalization data from the CHAMPS database, we have examined whether a women’s smoking history prior to entering the Navy is a prospective predictor of career outcomes and hospitalizations during Navy service. Identifying predictors of attrition, performance, and hospitalizations is an important first step for developing actions to prevent or circumvent the high costs associated with lifestyle-related early attrition, poor job performance, and health outcomes.

Body

Background and Significance of the Problem

More than 435,000 Americans die each year as a result of cigarette smoking. One in every five American deaths are cigarette-related, including 30% of all cancer deaths (87% of lung cancer deaths), 21% of deaths from coronary heart disease, 18% of stroke deaths, and 82% of deaths from chronic obstructive pulmonary disease (American Cancer Society, 2005; USDHHS, 1989a). Use of other forms of tobacco (e.g., cigars, pipes, snuff, or dip) also is associated with significantly elevated morbidity and mortality (USDHHS, 1986a), as is chronic exposure to secondhand smoke (Eriksen, LeMaistre, & Newell, 1988; EPA, 1993; USDHHS, 1986b). Smoking also imposes a considerable financial burden on society, with treatment of smoking related diseases costing \$50-73 billion a year (Warner, Hodgson, & Carroll, 1999), and \$584 million within the U.S. Department of Defense (Helyer, Brehm, & Perino, 1998). In both the civilian and military sectors, smoking has been linked to disability and job related outcomes, including decreased productivity, increased absenteeism, and long and more frequent work breaks (Centers for Disease Control, 2002a; Helyer, Brehm, & Perino, 1998).

Tobacco use is of particular concern to the U.S. Department of Defense (DOD) because the military historically has had higher and heavier rates of tobacco use than civilians (Bray, Hourani, Rae, Dever, Brown, Vincus, Pemberton, Marsden, Faulkner & Vandermaas-Peeler, 2003; Conway, 1998; Woodruff, Conway, Edwards, & Elder, 1999). Although smoking in the military decreased dramatically from 1980 to the mid-1990s (Kroutil, Bray, & Marsden, 1994), there was a statistically significant increase from 1998 to 2002, marking the first increase in two decades (Bray, Hourani, & Rae, et al., 2003). Past-month cigarette smoking continues to exceed *Healthy People 2010* objectives of 12%, with 33.8% of military personnel smoking in the past month in 2002 (Bray, Hourani, & Rae, et al., 2003).

Previous research indicates that cigarette smoking in the military has adverse effects on personnel health, performance, physical fitness, and attrition (Conway & Cronan, 1988; Conway & Cronan, 1992; Klesges, Haddock, Chang, Talcott, & Lando, 2001, Larson & Kewley, 2000). Numerous studies have concluded that there are negative relationships between smoking and success in combat training in military personnel (Blake & Parker, 1991; Zadoo, Fengler, & Catterson, 1993). Smokers tend to exercise less and perform more poorly on military physical fitness tests (Bahrke, Baur, Poland, & Connors, 1988; Conway & Cronan, 1988; Conway & Cronan, 1992). In addition, studies show high rates of smoking persist even after discharge from military service (Feigelman, 1994; Klevens, Giovino, Peddicord, Nelson, Mowery, & Grummer-Strawn, 1995). A recent concern among military health officials is the skyrocketing smoking rates among soldiers in Iraq, the post-deployment implications of which are not yet known.

Another adverse effect of smoking that has recently gained attention is early attrition from military service. First-term attrition is one of the most serious and costly personnel problems faced by the U.S. military (Laurence, Naughton, & Harris, 1996). A study conducted by Klesges and colleagues (2001) of a large number of U.S. Air Force recruits found smoking to be the best single predictor of early discharge over a 12-month period, with smoking associated with \$130 million per year in excess training costs extrapolated across all the military services. The Klesges, Haddock, & Change, et al. (2001) study sample was predominantly male, and did not report the effects of smoking separately for males and females, so it might be questioned whether the smoking and early attrition effects would hold for females as well as males.

The present study examined an all-female cohort entering the U.S. Navy between March 1996 – March 1997. To conduct analyses, two existing datasets were combined. The first dataset was from “Operation Stay Quit” (OSQ), a study in which the smoking history of 5,503 women just entering Navy recruit training was assessed. The second dataset consisted of personnel and medical data gathered from the Career History Archival Medical and Personnel System (CHAMPS), a database maintained by the Naval Health Research Center, San Diego. OSQ smoking history data and CHAMPS data were matched to produce a combined dataset in which women recruits’ self-reported cigarette smoking just prior to entering the Navy could be examined as a prospective predictor of Navy performance over a possible 7-8 year follow-up period. Groups based on self-reported smoking history as “daily smokers” vs. non-daily “other smokers” vs. “never smokers” at entry into the Navy were examined to assess prospectively the relationship between smoking at entry into the Navy and subsequent career outcomes.

For this final report, research accomplishments associated with each task outlined in the approved Statement of Work are described below.

STATEMENT OF WORK:

TASK 1. Prepare the tobacco-related OSQ and CHAMPS datasets for merging into linked files suitable for conducting secondary data analyses.

a. Prepare identification codes (IDs) for matching individuals in the OSQ dataset with events in the CHAMPS dataset so that personal identifying information (e.g., SSNs) will not be included in the merged files used for secondary analyses.

b. Finalize the variables of interest from the CHAMPS data for inclusion in the secondary analyses.

c. Match OSQ participants' records with all of their events occurring in the CHAMPS dataset.

COMPLETED. TASK 1 has been completed. Operation Stay Quit (OSQ) participants' social security numbers (SSNs) were used to link their baseline tobacco use data with personnel and medical information from the Career History Archival Medical and Personnel System (CHAMPS). The CHAMPS database, maintained at the Naval Health Research Center in San Diego, is a dynamic electronic system used to archive personnel and medical hospitalization information for active duty Navy personnel (Garland, Helmkamp, Gunderson, Gorham, Miller, McNally, & Thompson, 1987; Gunderson, Garland, Miller, & Gorham, 2005). Procedures were used to ensure that SSNs never appeared in the *merged* database, thereby protecting participants' confidentiality. To accomplish this, a new dummy ID code was first created for each of the 5,503 OSQ participants. A file containing participants' SSNs and new dummy ID codes (but no tobacco use data) was then used to extract personnel/medical data elements from CHAMPS. SSNs were stripped from the resulting CHAMPS data file extract, and that file was then merged with the tobacco use data using the dummy ID code. These steps ensured that individuals were not identifiable on the merged data file used in the present study. Furthermore, the merging of OSQ participants' tobacco use data and CHAMPS data was very successful—only 16 of 5,503 individual SSNs did not match.

Progress during the first year of the project primarily involved extensive preparatory work with the CHAMPS database. This electronic system includes information from 1961 up to the current time. CHAMPS is composed of fixed-block records based on career “events.” These events indicate a personnel action related to military accession, change in pay grade, term of service, or duty station, unauthorized absence, discharge or separation from service, and medical inpatient hospitalizations. All events for an individual service member can be extracted and displayed as a career narrative or saved in an electronic database as a variable length record with “events” sequenced in chronological order. The objective for this project was to create a rectangular file with the CHAMPS records ordered by case that could be merged with the existing database from OSQ. Several steps were required to develop this file.

The extraction of personnel and medical “events” for the OSQ sample was completed by downloading all “events” that matched the social security numbers of OSQ participants. Of the original 5,503 women in the study, data were extracted for 5,487 participants. There were 16 participants for whom the social security number in the OSQ database did not match with CHAMPS.

Step 1 required grouping all “event” records by type. A 3-digit number on each event record codes the type of “event.” Based on this code, “events” were grouped and written to 8 different files. The distribution of events is shown in Table 1. A record with demographic information was saved in a separate file (n=5,487).

Table 1. Distribution of Personnel and Medical Inpatient Events for the Sample of 5,487 Women

<i>Type of Event</i>	<i>Event Code</i>	<i>Number of Events</i>
Military Accession	100-198	7518
Pay Grade	327-330	17,091
Extension of Enlistment	382-387	7455
Duty Station Change	501-503	25,854
Unauthorized Absence/ Desertion	391, 591	223
Discharge from Service	800-943, 952-999	5830
Medical Inpatient	601-608	8289
Miscellaneous	250,301,344,345,347,348, 349,613,660,661,662	4830
Total		77,090

Step 2 built a rectangular file by case for each event type based on the maximum number of such events for any case. The distribution of records for each category of events is shown in Table 2.

Table 2. Maximum Number of Personnel and Medical Inpatient Event Categories for the Sample of 5,487 Women

<i>Type of Event</i>	<i>Maximum No. Events</i>
Military Accession	4
Pay Grade	12
Extension of Enlistment	12
Duty Station Change	15
Unauthorized Absence/ Desertion	7
Discharge from Service	4
Medical Inpatient	15
Miscellaneous	7

Step 3 merged the records from the 8 “event” files.

Step 4 added the demographic record to build a complete record for each participant.

Step 5 replaced the social security number with a unique study identification number and omitted the name field. These latter two changes were done to protect the privacy of the participants. This file was provided to SDSU for merging with the OSQ study tobacco history data.

TASK 2. *Finalize analysis plans, conduct secondary data analyses, summarize results, and prepare report.*

- a. Finalize plans for data analysis.*
- b. Conduct all planned statistical analyses.*
- c. Summarize results and prepare final report.*

COMPLETED. TASK 2 has been completed.

OVERVIEW

Two existing datasets were combined to conduct this study. The first was developed for a study funded by the Defense Women's Health Research Program through the U.S. Army Medical Research and Materiel Command (Grant #DAMD17-95-1-5075, *Improving Navy Women's Health: Preventing Smoking Relapse After Recruit Training*). In this study, called “Operation Stay Quit” (OSQ), 5,503 women recruits entering the U.S. Navy between March 1996 and March 1997 provided detailed information on their smoking history just prior to entering the Navy. During their first week of processing at Recruit Training Command (RTC), Great Lakes, recruits completed a baseline smoking survey as part of a larger longitudinal field intervention trial aimed at helping female recruits refrain from cigarettes once leaving the smoke-free environment at RTC (Conway, Woodruff, Edwards, Elder, Hurtado, & Hervig, 2004).

The second dataset consisted of personnel and medical data gathered from the Career History Archival Medical and Personnel System (CHAMPS), a database maintained by the Naval Health Research Center, San Diego (Garland, Helmkamp, & Gunderson, et al., 1987; Gunderson, Garland, & Miller, et al., 2005). By matching existing OSQ data (using social security numbers) on 5,503 women recruits with their subsequent career performance and hospitalization data from the CHAMPS database, it was possible to investigate whether women’s smoking history prior to entering the Navy was a prospective predictor of career outcomes and hospitalizations over a possible 7-8 year follow-up period.

All procedures used in this research were approved by the Institutional Review Boards at both San Diego State University and the Naval Health Research Center, San Diego.

PROCEDURES

Smoking Survey Measures

The smoking survey was a self-administered, optically-scannable questionnaire that assessed Navy women recruits' smoking status and their smoking and quitting history "prior to recruit training." Self-report smoking measures were based upon those used by other researchers investigating smoking and cessation among Navy and civilian populations (Becker, Conner, Waranch, Stillman, Pennington, Lees, & Oski, 1989; Bray, Marsden, & Peterson, 1991; Stanton, McClelland, Elwood, Ferry, Silva, 1996). The primary smoking variable for the present investigation was a 3-category measure based on two separate items asking individuals to: (a) report on the frequency of smoking (i.e., not applicable/don't smoke, every day, or some days), and (b) their perceptions of the type of smoker they are (i.e., never smoker, experimented, occasional, daily, or former). Based on our previous research, an individual's self-reported smoking status may vary depending on the wording of the item. Therefore, we used these two items (one behavioral and one based on perceptions) to derive smoking status. The three categories derived 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 they were experimenters, occasional smokers, some-days smokers, or former smokers, and the relatively few (n=86) who were inconsistent on the two items were categorized as Other smokers. The rationale for the inclusion of former and experimental smokers as Other smokers was based on previous studies of Navy personnel that suggest these individuals may be at risk for smoking regularly once joining the Navy (Cronan, Conway, & Kaszas, 1991).

CHAMPS Demographic, Attrition, Performance, and Hospitalization Variables

The CHAMPS database contains information on all enlisted members on active duty in the U.S. Navy since 1973 (see Gunderson et al., 2005 for a detailed description of CHAMPS). The database is a combination of (a) personnel records from Bureau of Personnel (BUPERS), and (b) medical data from the Navy Medical Information Management Center that includes inpatient hospitalizations and death records. The CHAMPS database organizes personnel and health data entries, or events, in chronological order by type of event (e.g., personnel, medical, discharge) and date. Thus, the database tracks all members from the date of accession to the date of separation or discharge from active duty.

The CHAMPS extract for the present study was conducted during June 2005. All but 16 OSQ recruits were successfully matched to CHAMPS. Demographic information, accession variables, attrition-related outcomes, performance data, and inpatient hospitalization information were extracted.

Demographic and accession variables included age computed at the time of the smoking survey, years of education upon entry into the Navy, and racial/ethnic group. Variables related to accession included length of enlistment obligation measured as 4 or 8 years, reserve versus regular enlistment status, and whether the recruit had ever been assigned sea duty.

Attrition-related variables included time in service computed from accession and discharge dates; type of attrition (i.e., completed obligated term, attrited after 1 year but before the end of one's obligated service, attrited before completing 1 year, and attrited during boot camp training at RTC) computed from accession and discharge dates; percent with less than an honorable/general discharge; reason for discharge using DOD loss-code groupings developed by the Naval Health Research Center; percent of discharges due to other groupings of interest, such as misconduct discharges that include those related to drug use (discharge codes 601-703, 811-904), drug use examined separately (discharge codes 701 and 703), and pregnancy (discharge code 340); and a severity-of-loss score, which is a measure of the severity of the reason for discharge, with scores ranging from 1 to 905. All discharge-related variables were based on the first discharge event because of the relatively small number of women with multiple discharge events.

Performance-related measures were typically summary measures already calculated and existing in the CHAMPS database. These included the total number of promotions, demotions, unauthorized absences, and desertions the service member received during her enlistment; whether or not the service member had been recommended for reenlistment some time during her career; whether or not the service member reenlisted subsequent to her first enlistment; the highest paygrade achieved during her career, with values ranging from 1 (Seaman Recruit) to 9 (Master Chief Petty Officer); and whether or not the service member had become an officer sometime during her career.

Hospitalization variables came from the CHAMPS inpatient event records. Each event record represents one hospital admission and includes the dates the patient was admitted and discharged, number of days hospitalized, type of release, and up to eight diagnoses (i.e., ICD-9 codes). For comparisons across smoking groups, only the first diagnosis code, which is always the *primary* diagnosis for admission, and number of days hospitalized for each event were examined.

Because almost two-thirds of the sample had no hospitalizations, and multiple hospitalizations were relatively rare, the total number of events per person was highly non-normal and skewed. Thus, for most comparisons a dichotomous indicator of whether a woman was ever hospitalized (yes or no) during her Navy career was used. Similarly, when primary diagnosis was examined by type of ICD-9 diagnostic category (USDHHS, 1989b), dichotomous measures were used to indicate "none vs. any" hospitalization with a primary diagnosis falling in one of the 19 ICD-9 categories. Total number of days spent hospitalized (summed across multiple hospitalizations) also was highly skewed; therefore, this variable was recoded into three groups: zero days hospitalized, 1-3 days, and 4 or more days spent hospitalized (the latter two groups are based on the median split for total days spent in the hospital among those ever hospitalized).

Description of the Sample

The sample was 5,503 enlisted female personnel entering the Navy between March 1996 and March 1997. The sample included 93% of the population. The 7% not participating (i.e., not completing the smoking survey) was due primarily to scheduling conflicts and introduced no sampling bias. The race/ethnicity distribution of participants was 58% White non-Hispanic, 23% African-American non-Hispanic, 12% Hispanic, 4% Asian/Pacific Islander, and 2.4% Native American. The mean age at entry to RTC was 19.7 years (SD=2.75), with 75% being 20 years of

age or younger. Most of the recruits had a high school diploma (90%), although 10% had less than a high school education. This was the first enlistment for all but 8 women. At the time of their accession, over 99% were single with no dependants. Eighty percent had entered the Navy under the Delayed Entry Program (DEP). The breakdown of the sample by smoking category (see description in the section on Smoking Survey Measures) was 45% Never smokers, 28% Other smokers, and 27% Daily smokers at entry into the Navy.

Analysis

Univariate analysis (i.e., chi-square analysis for categorical outcomes, logistic regression for dichotomous outcomes, ordinal regression for ordered outcomes, and analysis of variance (ANOVA) for continuous outcomes) were conducted to assess the relationships between smoking category and personnel/hospitalization outcomes from CHAMPS. Because of the large number of multiple comparisons and the large sample size, the overall p -value for a given test was required to be $p < .01$ for statistical significance. If the overall association from a chi-square analysis was statistically significant, the cell-by-cell adjusted residuals were used to assess which of the 3 groups differed from one another (Agresti, 1996). Similarly, Bonferroni post hoc tests were used for analyses with continuous outcomes to determine which groups differed. Time in service was used as a covariate in ANOVA and regression procedures because it is a likely confounder with other time-dependent outcomes (e.g., number of promotions, hospitalizations).

RESULTS

Smoking Category by Demographic, Attrition, and Performance Variables

Table 1 presents results evaluating the association of smoking category with demographic characteristics and accession-related variables. Smoking groups did not differ with regard to age at entry into the Navy, although Daily smokers had slightly less education than the other two groups. Race/ethnic background was a strong correlate of smoking at entry to RTC. Adjusted residuals indicated that differences were primarily between Never and Daily smokers. Daily smokers were predominately White non-Hispanic (80%), whereas Other smokers and particularly Never smokers, showed greater variability in their racial/ethnic composition. For example, Never smokers were comprised of about equal proportions of Whites and Blacks (39% and 41%, respectively). Never smokers had a significantly longer length of enlistment commitment than Daily smokers, and tended to have different types of enlistment than smokers. For example, compared to Other and Daily smokers, Never smokers were more likely to be reservists or regular/reserve combination (versus regular enlistment), and more likely to have been assigned to sea duty (including combat ships).

Table 1

Comparison of Smoking Groups on Demographic and Accession Variables

Demographic/Accession Variable	Mean (SD/SE) or %			F or χ^2
	Never Smoker	Other Smoker	Daily Smoker	
Age in years	19.8 (2.8)	19.8 (2.8)	19.7 (2.5)	ns
Years of education ^a	12.2 (.98)	12.1 (.90)	11.9 (.90)	28.90***
Racial/ethnic group (%) ^b				
White non-Hispanic	41	63	80	
Black	39	16	6	
Hispanic	13	15	8	
Asian/Pacific Islander	5	4	3	
American Indian	2	2	3	752.30***
Length of enlistment (%) ^b				
4-years	86.3	88.4	89.8	
8-years	13.7	11.6	10.2	11.20**
Percent Reservists ^b	17	15	12	20.36***
Percent Ever on Sea Duty ^a	49	43	42	25.0***

^a Daily smokers significantly different from other two categories

^b Daily smokers significantly different from Never smokers

^c Never smokers significantly different from other two categories

^d Never smokers significantly different from Other smokers

^e All groups different

** $p \leq .01$; *** $p \leq .001$

Note. n's for this table ranged from 5,199 to 5,481 due to small amounts of missing data in CHAMPS.

Table 2 presents attrition/retention variables by smoking category. A one-way ANOVA showed that all smoking groups differed significantly in average time in service, with Never smokers having the longest time in service, Daily smokers having the shortest, and Other smokers being intermediate. Never smokers were significantly more likely than Daily smokers to complete their obligated term and less likely to attrite early (i.e., during RTC, before 1 year of service, and after 1 year but before the end of obligated service). Other smokers were intermediate between Never and Daily smokers, but did not differ significantly from those two groups. Never smokers had significantly fewer less-than-honorable discharges than Daily smokers. Other smokers were intermediate, but not significantly different from the other two groups. Smoking groups differed significantly in their reasons for discharge (because discharges due to retirement and death were rare, these two reasons were not included in the overall chi-square test of associations between discharge reasons and smoking category). Standardized residuals indicated that for most reasons, the discrepancies between the two groups, Never and Daily smokers, were primarily the differences that accounted for the significant finding. Never smokers were more likely than Daily smokers to be discharged due to an officer commission, completion of service, or convenience of the government, and *less* likely than Daily smokers to be discharged for medical reasons, behavioral disorders, and personality disorders. Never smokers were less likely than *both* Other and Daily smokers to be discharged for medical reasons and sexual disorders. Daily smokers were significantly more likely to be discharged for the most serious type of discharge, punitive discharge, than Other smokers (but not Never smokers).

With regard to the specific groupings of reasons for discharge, two measures were statistically significant (Misconduct and Drug Use) and one was not (Pregnancy). Never smokers were significantly less likely than Daily smokers to be discharged due to misconduct or drug use. Pregnancy-related discharges, on the other hand, did not differ significantly among the three groups. All groups differed in their severity of loss scores. Daily smokers had the highest score, followed by Other smokers, and Never smokers had the lowest loss severity scores.

Table 2

Comparison of Smoking Groups on Attrition/Retention-related Outcomes

Attrition/Retention Variable	Mean (SD/SE) or %			F or χ^2
	Never Smoker	Other Smoker	Daily Smoker	
Time in Service (yrs) ^e	3.61 (1.80)	3.42 (1.88)	2.97 (1.98)	54.29***
Attrition categories (%) ^b				
Completed term	62.8	57.7	45.5	
Attrited after 1 year	24.9	26.8	31.2	
Attrited prior to 1 year	7.3	9.3	13.8	
Attrited during RTC	5.0	6.3	9.5	129.81***
Percent with less than honorable /general discharge ^b	2.8	4.3	6.5	31.08***
Reasons for Discharge (%)				
Officer commission ^b	1.1	.6	.2	
Retirement	.0	.0	.1	
Completion of service ^b	48.0	43.5	39.0	
Convenience of gov't ^b	30.8	30.4	24.8	
Medical ^c	5.8	7.5	7.6	
Death	.1	.1	.1	
Behavior disorder ^b	2.1	2.4	4.1	
Personality disorder ^b	8.2	11.7	18.7	
Sexual disorder ^c	.5	1.3	1.3	
Punitive ^f	3.3	2.4	4.2	157.71***
Discharges due to misconduct (%) ^b	6.8	8.4	15.6	82.86***
Discharges due to drug use (%) ^b	1.4	3.5	7.3	92.31***
Discharges due to pregnancy (%)	3.9	5.3	5.2	ns
Severity of loss score ^e	347.2 (177.7)	363.7 (185.2)	413.6 (209.4)	56.90***

^a Daily smokers significantly different from other two categories

^b Daily smokers significantly different from Never smokers

^c Never smokers significantly different from other two categories

^d Never smokers significantly different from Other smokers

^e All groups different

^f Daily smokers significantly different from Other smokers

** $p \leq .01$; *** $p \leq .001$

Note. n's for this table ranged from 5,281 to 5,438.

Table 3 presents performance-related variables by smoking category. In several analyses, time in service was used as a covariate because of its role as a confounder with other time-dependent outcomes measures, such as number of promotions during one's career. Number of promotions and number of unauthorized absences (UAs) did not differ significantly by smoking category after adjusting for time in service. However, the groups did differ in the number of demotions and desertions. Pair-wise contrasts using Never smokers as the reference group indicated that Never smokers had significantly fewer demotions and desertions than Daily smokers. Other smokers did not differ significantly from Never smokers. Because demotions, UAs, and desertions were relatively rare events with highly skewed distributions, the analyses were repeated after transforming those outcomes to natural logs. The results were essentially the same as those with non-transformed data.

A significantly higher percentage of Never smokers than Daily smokers had ever been recommended for reenlistment, and had actually reenlisted subsequent to the first enlistment. Other smokers were intermediate on the two reenlistment variables, but were not significantly different than the other two groups. With regard to the highest paygrade earned during their enlistment, all three groups were significantly different from one another. Never smokers had the highest mean paygrade level, followed by Other smokers, and then Daily smokers. There were not significant differences among the three smoking groups in the percent that earned officer status during their careers.

Table 3

Comparison of Smoking Groups on Performance-related Outcomes

Performance Variable	Mean (SD/SE) or %			F or χ^2
	Never Smoker	Other Smoker	Daily Smoker	
No. of promotions adj. for Time in Service (TIS)	2.20 (.022)	2.22 (.027)	2.17 (.027)	ns
No. of demotions adj. for TIS ^b	.070 (.006)	.080 (.008)	.103 (.008)	5.73**
No. of UAs adj. for TIS	.025 (.004)	.018 (.005)	.034 (.005)	ns
No. of desertions adj. for TIS ^b	.009 (.003)	.012 (.003)	.024 (.003)	6.99***
Recommended for reenlistment (%) ^b	82	78	69	89.20***
Percent reenlisted ^b	33	26	21	65.23***
Highest paygrade achieved ^{e,g}	4.05 (1.05)	3.95 (1.10)	3.69 (1.18)	44.98***
Officer accession (%)	0.9	0.9	0.4	ns

^a Daily smokers significantly different from other two categories

^b Daily smokers significantly different from Never smokers

^c Never smokers significantly different from other two categories

^d Never smokers significantly different from Other smokers

^e All groups different

^f Daily smokers significantly different from Other smokers

^g A paygrade value of 4 is equivalent to a 3rd Class Petty Officer.

** $p \leq .01$; *** $p \leq .001$

Note. n's for this table ranged from 4,860 to 5,448.

Smoking Category by Hospitalization Variables

For the sample as a whole, 65.1% of women had no hospitalization event during their service in the Navy; 24.6% had one hospitalization; 7.1% had two hospitalizations; and 3.2% had four or more (maximum was 15 hospitalizations). For those women (n = 1,914) that had one or more hospitalizations, the total number of days spent hospitalized (summed across all hospitalization events) averaged 5.8 days (median = 4; range 1-158) over 1.4 hospitalization events (median = 1; range 1-15).

Table 4 presents the hospitalization variables by smoking category. To test for significant differences by smoking groups, both cross-tabulation chi-squares and logistic or ordinal regressions were conducted, the latter with time in service entered as a covariate. For descriptive purposes, and since no changes in the patterns of results occurred whether or not time in service was included in the analyses, percents by smoking categories also are tabled. Based on either the cross-tabulation chi-squares or the regression results controlling for time in service, no significant ($p > .01$) differences across smoking groups were found for the any-hospitalization dichotomous measure, total days hospitalized while in the Navy, or ever-hospitalized with a diagnosis in one of the 19 ICD-9 diagnostic categories. It should also be noted that analyses were conducted using several different versions of the hospitalization outcome measures (e.g., any-hospitalization dichotomy, total number of hospitalizations, total hospitalizations capped at 3+ or 5+ to reduce skewness, the 3 subgroupings of days as well as total days hospitalized). However, the same general patterns of results were found regardless of the outcome measure or type of analysis done (e.g., cross-tabulation chi-square; logistic/ordinal regression or ANOVA controlling for time in service).

Table 4
Comparison of Smoking Groups on Hospitalization Outcomes

Hospitalization Variable	Percent			Significance of χ^2 & Wald ^a
	Never Smoker	Other Smoker	Daily Smoker	
Ever Hospitalized? (%)				
No	63.6	66.1	66.9	ns ^b
Yes	36.4	33.9	33.1	
Total Days Hospitalized (%)				
0	63.5	66.0	66.8	ns ^b
1-3	16.0	16.1	13.7	
4 or more	20.5	17.9	19.6	
Ever Hospitalized by ICD-9 Categories? (% Yes)				
01. Infectious	0.6	0.8	0.7	ns ^b
02. Neoplasms	0.5	0.4	0.1	ns ^b
03. Endocrine	0.5	0.1	0.3	ns ^c
04. Blood	0.1	0.1	0.1	ns ^c
05. Mental	5.1	4.3	6.3	ns ^b
06. Nervous	0.2	0.7	0.3	ns ^c
07. Circulatory	0.1	0.1	0.1	ns ^c
08. Respiratory	0.9	1.1	0.9	ns ^c
09. Digestive	2.1	1.2	1.6	ns ^b
10. Genitourinary	2.2	2.2	2.1	ns ^b
11. Pregnancy	24.8	23.8	21.3	ns ^b
12. Skin	0.3	0.5	0.6	ns ^c
13. Musculoskeletal	0.9	0.8	1.5	ns ^b
14. Congenital	0.1	0.2	0.2	ns ^c
15. Perinatal (not applicable)	n/a	n/a	n/a	--
16. Ill-Defined	1.0	0.6	0.9	ns ^c
17. Accidents	1.9	1.6	1.9	ns ^d
18. Supplementary	0.6	0.7	0.5	ns ^c
19. External Causes	0.0	0.0	0.0	--

^a Chi-squares from unadjusted cross-tabulations of hospitalization variables by smoking group and Wald statistics from logistic/ordinal regression, controlling for time in service, were assessed.

^b Chi-square and Wald for smoking groups were non-significant ($p > .01$), but Wald for time in service was significant ($p < .01$).

^c Chi-square and Walds for smoking groups and time in service were all non-significant ($p > .01$).

Note. n's for this table ranged from 5,430 to 5,487.

Key research accomplishments

- Smoking history data from a previously funded research, called “Operation Stay Quit” (OSQ), on almost 5,500 women recruits entering the U.S. Navy between March 1996 and March 1997 was successfully merged with personnel and medical data gathered from the Career History Archival Medical and Personnel System (CHAMPS), a database maintained by the Naval Health Research Center, San Diego.
- The merging of these two existing datasets provided the opportunity to examine an all-female cohort entering the U.S. Navy to examine whether cigarette smoking prior to entering the military would *prospectively* predict subsequent career outcomes and hospitalizations.
- For career outcomes, a consistent pattern of results was found: compared to Never smokers, Daily smokers at entry into the Navy were subsequently more likely to have poorer outcomes on a wide variety of Navy career indicators (e.g., shorter-term enlistments, more early attrition, more less-than-honorable discharges, more misconduct discharges, more demotions and desertions, achieved a lower final paygrade, be less likely recommended for reenlistment, and less likely actually to reenlist). The category of Other smokers (i.e., had smoked, but not daily at entry into the Navy) consistently fell between Never and Daily smokers on career outcome measures.
- For hospitalizations, no consistent differences among smoking groups were found.
- Findings from this study provide a greater understanding of the relationship between smoking and military service-related outcomes among Navy women. Such understanding is important considering that women are a significant source of personnel strength in the U.S. Navy.
- Unlike most previous studies, this research has had the ability to make *prospective* inferences about smoking as a risk factor for subsequent personnel-related outcomes specifically among military *women*.
- Findings from this study suggests that entering the Navy as a less regular smoker, rather than a Daily smoker, is likely to be associated with better career outcomes. An interesting empirical question is whether an intervention to help daily smokers either reduce their smoking to non-daily or become former smokers prior to entering the Navy could have an impact on subsequent career outcomes.
- The findings from this study have implications for additional research. Future research should evaluate the impact of smoking cessation intervention prior to entering the Navy to determine whether this can improve subsequent career outcomes.

Reportable outcomes

Conway TL & Woodruff SI (Hervig LK to be added after Navy review is completed). (2006—Under Review). “Women’s smoking history prior to entering the U.S. Navy: A prospective predictor of performance.” Manuscript has been submitted and is under review for publication in *Tobacco Control*.

The above manuscript also has been submitted as a Technical Report and is currently under review by the Naval Health Research Center and the U.S. Navy Bureau of Medicine.

Woodruff, S.I., Conway, T.L., & Hervig, L.K. (In Preparation). “Characterization of hospitalizations in a cohort of U.S. Navy women.” Manuscript currently in preparation and will be submitted to a peer-reviewed journal during 2006.

Conclusions

To our knowledge, no previous study has examined an all-female cohort entering a branch of the U.S. military to examine whether cigarette smoking prior to entering the military would prospectively predict subsequent career outcomes and hospitalizations. Comparisons among groups defined by self-reported smoking just prior to entering the U.S. Navy indicated a consistent pattern of results for career outcomes. Compared to Never smokers, Daily smokers at entry into the Navy were subsequently more likely to have poorer outcomes on a wide variety of Navy career indicators. Daily smokers were more likely than Never smokers to sign up for shorter-term enlistments, leave the Navy prior to serving a full-term enlistment (i.e., early attrition), and spend less overall time in naval service. Daily smokers also were more likely to receive less-than-honorable discharges, more misconduct (e.g., behavioral, personality, sexual, drug-related, and punitive) discharges, more demotions and desertions, achieve a lower final paygrade, be less likely recommended for reenlistment, and less likely actually to reenlist. The category of Other smokers (i.e., had smoked, but not daily at entry into the Navy) consistently fell between Never and Daily smokers on career outcome measures. Although we had hypothesized that there would be differences in the numbers and types of hospitalizations across smoking groups, no consistent patterns were found.

Findings from this study provide a greater understanding of the relationship between smoking and military service-related outcomes among Navy women. Such understanding is important as women are a significant source of personnel strength in the U.S. Navy, with about 59,000 women currently serving. Women are integrated into combat roles, the majority of Navy jobs are open to women, and women are expected to continue to comprise a significant portion of U.S. Navy personnel. As the numbers and opportunities expand for Navy women, a better understanding of the relationships among health, lifestyle, and job performance in women will become increasingly important.

Prior to this study, some information was available on the effects of smoking on military performance, costs, attrition, and service members’ health; however, there were important gaps in the knowledge base. For example, previous relevant studies have analyzed data from branches of

the armed services other than the Navy, extrapolating findings to Navy personnel rather than assessing them directly (Klesges, Haddock & Chang, et al., 2001). Also, most previous studies focused on smoking as a predictor of a single or few outcomes, such as excess training costs or absenteeism, or measured relatively short-term outcomes of smoking (e.g., attrition during the first year of enlistment) (Klesges, Haddock, & Chang, et al., 2001; Larson & Kewley, 2000; Zadoo, Fengler & Catterson, 1993). Little was known about the association of smoking with *longer-term* personnel outcomes, such as career advancement, disciplinary problems, and reenlistment decisions. Most previous studies have been descriptive, ecological, or based on aggregated data, limiting the ability to make prospective inferences about smoking as a risk factor for subsequent personnel-related outcomes. Finally, military *women* often are not included in previous studies, or their smoking and outcome data are combined with men's and not presented separately. Recent studies suggest that smoking initiation, smoking maintenance, cessation experiences, relapse patterns, and even biological and genetic sensitivity to the damaging effects of smoking may be different for women and men (Centers for Disease Control, 2002b; Langhammer, Johnsen, Holmen, Gulsvik, & Bjermer, 2000; Li, Cheng, Ma, & Swan, 2003; Prescott, Osler, Anderson, Hein, Borch-Johnsen, Lange, Schnohr, & Vestbo, 1998). Thus, it was important to examine the association of smoking with subsequent personnel and job-related outcomes separately for women.

The findings from this study have implications for additional research. As a group, Daily smokers at entry into the Navy consistently had the poorest career outcomes during their time in the service when compared to Never or Other smokers. While Never smokers typically had the best outcomes, Other smokers generally fell in between Never and Daily smokers. This general trend suggests that entering the Navy as a less regular smoker, rather than a Daily smoker, is likely to be associated with better career outcomes. An interesting empirical question is whether an intervention to help daily smokers either reduce their smoking to non-daily or become former smokers *prior* to entering the Navy could have an impact on subsequent career outcomes. The Delayed Entry Program (DEP), in which many recruits participate prior to entry into the Navy, could provide an ideal opportunity for smoker-enlistees to take part in smoking cessation programs. Future research should evaluate the impact of smoking cessation intervention prior to entering the Navy to determine whether this can improve subsequent career outcomes.

References

- Agresti A. *An introduction to categorical data analysis*. John Wiley & Sons, Inc: New York, 1996.
- American Cancer Society. *Cancer Facts & Figures*, 2005.
- Bahrke MS, Baur TS, Poland DF, & Connors DF. Tobacco use and performance on the U.S. Army physical fitness test. *Military Medicine* 1988;153:229-235.
- Becker DM, Conner HF, Waranch HR, Stillman F, Pennington L, Lees PS & Oski, F. The impact of a total ban on smoking in the Johns Hopkins Children's Center. *J Am Med Assoc* 1989;262(6):799-802.
- Blake GH & Parker JA. Success in combat training: The role of cigarette smoking. *Journal of Occupational Medicine* 1991;33:688-690.
- Bray RM, Marsden ME, & Peterson MR. Standardized comparisons of the use of alcohol, drugs, and cigarettes among military personnel and civilians. *Am J Public Health* 1991;81(7):865-869.
- Bray RM, Hourani LL, Rae KL, Dever JA, Brown JM, Vincus AA, Pemberton MR, Marsden ME, Faulkner DL, & Vandermaas-Peeler R. *2002 Department of Defense survey of health related behaviors among military personnel: final report* (prepared for the Assistant Secretary of Defense [Health Affairs], U.S. Department of Defense, Cooperative Agreement No. DAMD17-00-2-0057, RTI/7841/006-FR). Research Triangle Park, NC: RTI International, 2003.
- Centers for Disease Control (CDC). Annual smoking-attributable mortality, years of potential life lost, and economic costs—United States, 1995-1999. *MMWR Morb Mortal Wkly Rep* 2002a;51(14): 300-303.
- Centers for Disease Control (CDC). Women and smoking: a report of the Surgeon General. Executive summary. *MMWR* 2002b;51(RR-12):i-iv:1-13.
- Conway TL. Tobacco use and the United States military: a longstanding problem. *Tobacco Control* 1998;7:219-221.
- Conway TL & Cronan TA. Smoking and physical fitness among Navy shipboard personnel. *Military Medicine* 1988;153(11):589-594.
- Conway TL & Cronan TA. Smoking, exercise, and physical fitness. *Preventive Medicine* 1992;21(6):723-734.

- Conway TL, Woodruff SI, Edwards CC, Elder JP, Hurtado SL, & Hervig LK. Operation Stay Quit: evaluation of two smoking relapse prevention strategies for women after involuntary cessation during U.S. navy recruit training. *Military Medicine* 2004;169(3):236-242.
- Cronan TA, Conway TL, & Kaszas SL. Starting to smoke in the Navy: when, where and why? *Social Science & Medicine* 1991;33(12):1349-1353.
- Environmental Protection Agency (EPA). *Respiratory health effects of passive smoking: Lung cancer and other disorders*. NIH Publication No. 93-3605. Washington DC: Office of Health and Environmental Assessment, 1993.
- Eriksen MP, LeMaistre CA, & Newell GR. Health hazards of passive smoking. *Annual Review of Public Health* 1988;9: 47-70.
- Feigelman W. Cigarette smoking among former military service personnel: A neglected social issue. *Preventive Medicine* 1994;23:235-241.
- Garland, FC, Helmkamp, JC, Gunderson, EKE, Gorham, ED, Miller, MM, McNally, MS, & Thompson, FA, *A guide to the computerized medical data resources of the Naval Health Research Center*, Report No. 87-13, Naval Health Research Center, 1987.
- Gunderson EKE, Garland CF, Miller MR, & Gorham ED. Career history archival medical and personnel system. *Military Medicine* 2005;170:172-175.
- Helyer AJ, Brehm WT, & Perino L. Economic consequences of tobacco use for the Department of Defense, 1995. *Military Medicine* 1998;163:217-221.
- Klesges RC, Haddock CK, Chang CF, Talcott GW, & Lando HA. The association of smoking and the cost of military training. *Tobacco Control* 2001;10:43-47.
- Klevens RM, Giovino GA, Peddicord JP, Nelson DE, Mowery P, & Grummer-Strawn L. The association between veteran status and cigarette-smoking behaviors. *American Journal of Preventive Medicine* 1995;11(4): 245-250.
- Kroutil LA, Bray RM, & Marsden ME. Cigarette smoking in the U.S. military: Findings from the 1992 Worldwide Survey. *Preventive Medicine* 1994;23:521-528.
- Langhammer A, Johnsen R, Holmen J, Gulsvik A, & Bjermer L. Cigarette smoking gives more respiratory symptoms among women than among men. The Nord-Trondelag Health Study (HUNT). *Journal of Epidemiology and Community Health* 2000;54(12):917-22.
- Larson GE & Kewley SB. *First-term attrition in the Navy: causes and proposed solutions* (NHRC Report No. 00-27). San Diego, CA: Naval Health Research Center, 2000.

Laurence JH, Naughton J, & Harris DA. *Attrition revisited: identifying the problem and its solutions* (ARI Research Note 96-20). Alexandria, VA: Army Research Institute, 1996.

Li MD, Cheng R, Ma JZ, & Swan, GE. A meta-analysis of estimated genetic and environmental effects on smoking behavior in male and female adult twins. *Addiction* 2003;98(1):23-31.

Prescott E, Osler M, Anderson PK, Hein HO, Borch-Johnsen K, Lange P, Schnohr P, & Vestbo J. Mortality in women and men in relation to smoking. *International Journal of Epidemiology* 1998;27:27-32.

Stanton WR, McClelland M, Elwood C, Ferry D, & Silva PA. Prevalence, reliability and bias of adolescents' reporting of smoking and quitting. *Addiction* 1996;91(11): 1705-1714.

U.S. Department of Health and Human Services (USDHHS). *The health consequences of using smokeless tobacco. A report of the advisory committee to the Surgeon General, (1986)*. U.S. Department of Health and Human Services, Public Health Service Publication No. 86-28774, 1986a.

U.S. Department of Health and Human Services (USDHHS). *The health consequences of involuntary smoking. A report of the Surgeon General*. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control. DHHS Publication No. (CDC) 87-8398, 1986b.

U.S. Department of Health and Human Services (USDHHS). *Reducing the health consequences of smoking: 25 years of progress. A report of the Surgeon General*. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 1989a.

U.S. Department of Health and Human Services (USDHHS). *International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM)*, 3rd Edition, Vol. 1 (DHHS Publication No. (PHS) 89-1260), 1989b.

Warner KE, Hodgson TA, & Carroll CE. Medical costs of smoking in the United States: estimates, their validity, and their implications. *Tobacco Control* 1999;8:290-300.

Woodruff SI, Conway TL, Edwards CC, & Elder JP. The United States navy attracts young women who smoke. *Tobacco Control* 1999;8:222-223.

Zadoo V, Fengler S, & Catterson M. The effects of alcohol and tobacco on troop readiness. *Military Medicine* 1993;158:480-484.

Appendices

Appendix A (see below): Manuscript submitted for publication in *Tobacco Control* entitled "Women's Smoking History Prior to Entering the U.S. Navy: A Prospective Predictor of Performance."

Appendix A

Women's Smoking History Prior to Entering the U.S. Navy: A Prospective Predictor of Performance

Terry L. Conway, PhD¹ and Susan I. Woodruff, PhD¹

¹ San Diego State University, Graduate School of Public Health, 9245 Sky Park Court, Suite 120, San Diego, CA 92123

Correspondence author: Terry L. Conway, PhD, San Diego State University, Graduate School of Public Health, 9245 Sky Park Court, Suite 120, San Diego, CA 92123. Phone: (619) 594-8044, Fax: (619) 594-3143, email: tconway@mail.sdsu.edu

Key words: women, smoking history, prospective study, attrition, job performance

This research was supported by the FY03 Department of Defense (DOD) Peer Reviewed Medical Research Program (PRMRP) Supplement to the U.S. Army Medical Research and Materiel Command (USAMRMC), award no. W81XWH-04-1-0203.

NOTHING ON THIS PAGE IS PROPRIETARY INFORMATION

Proposal Page 25

**Women's Smoking History Prior to Entering the U.S. Navy:
A Prospective Predictor of Performance**

Abstract

Objective – To examine whether women's tobacco use prior to entering the U.S. Navy is predictive of subsequent career performance. *A priori* predictions were that smoking at entry into the Navy would be related to early attrition, poorer job performance, more disciplinary problems, and lower likelihood of reenlistment.

Design – A prospective cohort analysis.

Setting – U.S. Navy.

Participants – 5,487 women entering the U.S. Navy between March 1996 and March 1997.

Main outcome measures – Navy career performance measures, such as time in service, early attrition, type of discharge, misconduct, number of promotions/demotions/unauthorized absences, highest paygrade achieved, and recommendation for reenlistment.

Results – Compared to Never smokers, Daily smokers at *entry* into the U.S. Navy had subsequent career outcomes consistently indicating poorer job performance (e.g., early attrition prior to serving a full-term enlistment, more likely to have a less-than-honorable discharge, more demotions and desertions, lower achieved paygrade, and less likely to be recommended for and reenlist). Other types of smokers consistently fell between Never and Daily smokers on career outcome measures.

Conclusions – For women entering the U.S. Navy, being a Daily smoker is a prospective predictor of poorer performance in the Navy. Future research should evaluate the effectiveness of cessation intervention with smoker-enlistees prior to their entering the Navy to assess the impact on subsequent career outcomes.

What this paper adds:

To our knowledge, no previous study has examined an all-female cohort entering a branch of the U.S. military to examine whether cigarette smoking prior to entering the military is a prospective predictor of subsequent career experiences and performance. Comparisons were made among groups defined by self-reported smoking just prior to entering the U.S. Navy as Daily smokers, non-daily Other smokers, and Never smokers. A consistent pattern of results indicated that, compared to Never smokers, Daily smokers at entry into the Navy were subsequently more likely to have poorer outcomes on a wide variety of Navy career indicators.

Women's Smoking History Prior to Entering the U.S. Navy:

A Prospective Predictor of Performance

Background and Significance of the Problem

More than 435,000 Americans die each year as a result of cigarette smoking. One in every five American deaths are cigarette-related, including 30% of all cancer deaths (87% of lung cancer deaths), 21% of deaths from coronary heart disease, 18% of stroke deaths, and 82% of deaths from chronic obstructive pulmonary disease.^{1,2} Use of other forms of tobacco (e.g., cigars, pipes, snuff, or dip) also is associated with significantly elevated morbidity and mortality,³ as is chronic exposure to secondhand smoke.⁴⁻⁶ Smoking also imposes a considerable financial burden on society, with treatment of smoking related diseases costing \$50-73 billion a year,⁷ and \$584 million within the U.S. Department of Defense.⁸ In both the civilian and military sectors, smoking has been linked to disability and job related outcomes, including decreased productivity, increased absenteeism, and long and more frequent work breaks.⁸⁻⁹

Tobacco use is of particular concern to the U.S. Department of Defense (DOD) because the military historically has had higher and heavier rates of tobacco use than civilians.¹⁰⁻¹² Although smoking in the military decreased dramatically from 1980 to the mid-1990s,¹³ there was a statistically significant increase from 1998 to 2002, marking the first increase in two decades.¹⁰ Past-month cigarette smoking continues to exceed *Healthy People 2010* objectives of 12%, with 33.8% of military personnel smoking in the past month in 2002.¹⁰

Previous research indicates that cigarette smoking in the military has adverse effects on personnel health, performance, physical fitness, and attrition.¹⁴⁻¹⁶ Numerous studies have concluded that there are negative relationships between smoking and success in combat training in military personnel.¹⁷⁻¹⁸ Smokers tend to exercise less and perform more poorly on military

physical fitness tests.^{14,19-20} In addition, studies show high rates of smoking persist even after discharge from military service.²¹⁻²² A recent concern among military health officials is the skyrocketing smoking rates among soldiers in Iraq, the post-deployment implications of which are not yet known.

Another adverse effect of smoking that has recently gained attention is early attrition from military service. First-term attrition is one of the most serious and costly personnel problems faced by the U.S. military.²³ A study conducted by Klesges and colleagues¹⁵ of a large number of U.S. Air Force recruits found smoking to be the best single predictor of early discharge over a 12-month period, with smoking associated with \$130 million per year in excess training costs extrapolated across all the military services. The Klesges et al.¹⁵ study sample was predominantly male, and did not report the effects of smoking separately for males and females, so it might be questioned whether the smoking and early attrition effects would hold for females as well as males.

The present study examined an all-female cohort of women entering the U.S. Navy between March 1996 – March 1997. Self-reported cigarette smoking just prior to entering the Navy was examined as a prospective predictor of Navy performance over a possible 7-8 year follow-up period. Groups based on self-reported smoking history as “daily smokers” vs. non-daily “other smokers” vs. “never smokers” at entry into the Navy were examined to assess prospectively the relationship between smoking history reported just prior to entering the Navy and subsequent career performance.

Methods

Procedures

Two existing datasets were combined to conduct this study. The first dataset was developed for a study funded by the Defense Women's Health Research Program administered by

the U.S. Army Medical Research and Materiel Command (Grant #DAMD17-95-1-5075, “Improving Navy Women's Health: Preventing Smoking Relapse After Recruit Training”). In this study, called “Operation Stay Quit” (OSQ), 5,503 women recruits entering the U.S. Navy between March 1996 and March 1997 provided detailed information on their smoking history just prior to entering the Navy. During their first week of processing at Recruit Training Command (RTC), Great Lakes, Illinois, recruits completed a baseline smoking survey as part of a larger longitudinal field intervention trial aimed at helping female recruits refrain from cigarette smoking after leaving the smoke-free environment at RTC.²⁴

The second dataset consisted of personnel and medical data gathered from the Career History Archival Medical and Personnel System (CHAMPS), a database maintained by the Naval Health Research Center, San Diego. By matching existing OSQ data (using social security numbers) on 5,503 women recruits with their subsequent career performance and hospitalization data from the CHAMPS database, it was possible to investigate whether women’s smoking history prior to entering the Navy was a prospective predictor of career outcomes and hospitalizations after 7-8 years of Navy service.

All procedures used in this research were approved by the Institutional Review Boards at both San Diego State University and Naval Health Research Center, San Diego.

Smoking Survey Measures

The smoking survey was a self-administered, optically-scannable questionnaire that assessed Navy women recruits’ smoking status and their smoking and quitting history “prior to recruit training” (i.e., prior to entering the Navy). Self-report smoking measures were based upon those used by other researchers investigating smoking and cessation among Navy and young civilian populations.²⁵⁻²⁷ The primary smoking variable for the present investigation was a 3-

category measure based on two separate items asking individuals to: (a) report on the frequency of smoking (i.e., not applicable/don't smoke, every day, or some days), and (b) their perceptions of the type of smoker they are (i.e., never smoker, experimented, occasional, daily, or former). Based on our previous research, an individual's self-reported smoking status may vary depending on the wording of the item. Therefore, we used these two items (one behavioral and one based on perceptions) to derive smoking status. The three categories derived 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 they were experimenters, occasional smokers, some-days smokers, or former smokers, and the relatively few (n=86) who were inconsistent on the two items were categorized as Other smokers. The rationale for the inclusion of former and experimental smokers as Other smokers was based on previous studies of Navy personnel that suggest these individuals may be at risk for smoking regularly once joining the Navy.²⁸

CHAMPS Demographic, Attrition, Performance, and Hospitalization Variables

The CHAMPS database contains information on all enlisted members on active duty in the U.S. Navy since 1973 (see Gunderson et al.²⁹ for a detailed description of CHAMPS). The database is a combination of (a) personnel records from Bureau of Personnel (BUPERS), and (b) medical data from the Navy Medical Information Management Center that includes inpatient hospitalizations and death records. The CHAMPS database organizes personnel and health data entries, or events, in chronological order by type of event (e.g., personnel, medical, discharge) and date. Thus, the database tracks all members from the date of accession to the date of separation or discharge from active duty.

The CHAMPS extract for the present study was conducted during June 2005. All but 16 OSQ recruits were successfully matched to CHAMPS. Demographic information, accession variables, attrition-related outcomes, performance data, and inpatient hospitalization information were extracted.

Demographic and accession variables included age computed at the time of the smoking survey; years of education upon entry into the Navy; and racial/ethnic group. Variables related to accession included length of enlistment obligation measured as 4 or 8 years, reserve versus regular enlistment status, and whether the recruit had ever been assigned sea duty.

Attrition-related variables included time in service computed from accession and discharge dates; type of attrition (i.e., completed obligated term, attrited after 1 year but before the end of one's obligated service, attrited before completing 1 year, and attrited during boot camp training at RTC) computed from accession and discharge dates; percent with less than an honorable/general discharge; reason for discharge using DOD loss-code groupings developed by the Naval Health Research Center; percent of discharges due to other groupings of interest, such as misconduct discharges that include those related to drug use (discharge codes 601-703, 811-904), drug use examined separately (discharge codes 701 and 703), and pregnancy (discharge code 340); and a severity-of-loss score, which is a measure of the severity of the reason for discharge, with scores ranging from 1 to 905. All discharge-related variables were based on the first discharge event because of the relatively small number of women with multiple discharge events.

Performance-related measures were typically summary measures already calculated and existing in the CHAMPS database. These included the total number of promotions, demotions, unauthorized absences, and desertions the servicemember received during her enlistment; whether or not the servicemember had been recommended for reenlistment some time during her career; whether or not the servicemember reenlisted subsequent to her first enlistment; the highest paygrade achieved during her

career, with values ranging from 1 (Seaman Recruit) to 9 (Master Chief Petty Officer); and whether or not the servicemember had become an officer sometime during her career.

Description of the Sample

The sample was 5,503 enlisted female personnel entering the Navy between March 1996 and March 1997. The sample included 93% of the population. The 7% not participating (i.e., not completing the smoking survey) was due primarily to scheduling conflicts and introduced no sampling bias. The race/ethnicity distribution of participants was 58% White non-Hispanic, 23% African-American non-Hispanic, 12% Hispanic, 4% Asian/Pacific Islander, and 2.4% Native American. The mean age at entry to RTC was 19.7 years (SD=2.75), with 75% being 20 years of age or younger. Most of the recruits had a high school diploma (90%), although 10% had less than a high school education. This was the first enlistment for all but 8 women. At the time of their accession, over 99% were single with no dependants. Eighty percent had entered the Navy under the Delayed Entry Program (DEP). The breakdown of the sample by smoking category (see description in the section on Smoking Survey Measures) was 45% Never smokers, 28% Other smokers, and 27% Daily smokers at entry into the Navy.

Analysis

Univariate analysis (i.e., chi-square analysis for categorical outcomes and one-way analysis of variance (ANOVA) for continuous level outcomes) were conducted to assess the relationship between smoking category and personnel outcomes from CHAMPS. If the association from a chi-square analysis was statistically significant at the .05 level, the cell-by-cell adjusted residuals were used to determine which of the 3 groups differed from one another.³⁰ Similarly, Bonferroni posthoc tests were used for analyses with continuous outcomes to determine which groups

differed. Time in service was used as a covariate in several ANOVA procedures because it is a likely confounder with other time-dependent outcomes (e.g., number of promotions).

Results

Table 1 presents results of univariate analysis evaluating the association of smoking category with demographic characteristics and accession-related variables. Smoking groups did not differ with regard to age at entry into the Navy, although Daily smokers had slightly less education than the other two groups. Race/ethnic background was a strong correlate of smoking at entry to RTC. Adjusted residuals indicated that differences were primarily between Never and Daily smokers. Daily smokers were predominately White non-Hispanic (80%), whereas Other smokers and particularly Never smokers, showed greater variability in their racial/ethnic composition. For example, Never smokers were comprised of about equal proportions of Whites and Blacks (39% and 41%, respectively). Never smokers had a significantly longer length of enlistment commitment than Daily smokers, and tended to have different types of enlistment than smokers. For example, compared to Other and Daily smokers, Never smokers were more likely to be reservists or regular/reserve combination (versus regular enlistment), and more likely to have been assigned to sea duty (including combat ships).

Table 1

Comparison of Smoking Groups on Demographic and Accession Variables

Demographic/Accession Variable	Mean (SD/SE) or %			F or χ^2
	Never Smoker	Other Smoker	Daily Smoker	
Age in years	19.8 (2.8)	19.8 (2.8)	19.7 (2.5)	ns
Years of education ^a	12.2 (.98)	12.1 (.90)	11.9 (.90)	28.90***
Racial/ethnic group (%) ^b				
White non-Hispanic	41	63	80	
Black	39	16	6	
Hispanic	13	15	8	
Asian/Pacific Islander	5	4	3	
American Indian	2	2	3	752.30***
Length of enlistment (%) ^b				
4-years	86.3	88.4	89.8	
8-years	13.7	11.6	10.2	11.20**
Percent Reservists ^b	17	15	12	20.36***
Percent Ever on Sea Duty ^a	49	43	42	25.0***

^a Daily smokers significantly different from other two categories

^b Daily smokers significantly different from Never smokers

^c Never smokers significantly different from other two categories

^d Never smokers significantly different from Other smokers

^e All groups different

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Note. n's for this table ranged from 5,199 to 5,481 due to small amounts of missing data in CHAMPS.

Table 2 presents attrition/retention variables by smoking category. A one-way ANOVA showed that all smoking groups differed significantly in average time in service, with Never smokers having the longest time in service, Daily smokers having the shortest, and Other smokers being intermediate. Never smokers were significantly more likely than Daily smokers to complete their obligated term and less likely to attrite early (i.e., during RTC, before 1 year of service, and after 1 year but before the end of obligated service). Other smokers were intermediate between Never and Daily smokers, but did not differ significantly from those two groups. Never smokers had significantly fewer less-than-honorable discharges than Daily smokers. Other smokers were intermediate, but not significantly different from the other two groups. Smoking groups differed significantly in their reasons for discharge (because discharges due to retirement and death were rare, these two reasons were not included in the overall chi-square test of associations between discharge reasons and smoking category). Standardized residuals indicated that for most reasons, the discrepancies between the two groups, Never and Daily smokers, were primarily the differences that accounted for the significant finding. Never smokers were more likely than Daily smokers to be discharged due to an officer commission, completion of service, or convenience of the government, and *less* likely than Daily smokers to be discharged for medical reasons, behavioral disorders, and personality disorders. Never smokers were less likely than *both* Other and Daily smokers to be discharged for medical reasons and sexual disorders. Daily smokers were significantly more likely to be discharged for the most serious type of discharge, punitive discharge, than Other smokers (but not Never smokers).

Table 2

Comparison of Smoking Groups on Attrition/Retention-related Outcomes

Attrition/Retention Variable	Mean (SD/SE) or %			F or χ^2
	Never Smoker	Other Smoker	Daily Smoker	
Time in Service (yrs) ^e	3.61 (1.80)	3.42 (1.88)	2.97 (1.98)	54.29***
Attrition categories [%] ^b				
Completed term	62.8	57.7	45.5	
Attrited after 1 year	24.9	26.8	31.2	
Attrited prior to 1 year	7.3	9.3	13.8	
Attrited during RTC	5.0	6.3	9.5	129.81***
Percent with less than honorable /general discharge ^b	2.8	4.3	6.5	31.08***
Reasons for Discharge (%)				
Officer commission ^b	1.1	.6	.2	
Retirement	.0	.0	.1	
Completion of service ^b	48.0	43.5	39.0	
Convenience of gov't ^b	30.8	30.4	24.8	
Medical ^c	5.8	7.5	7.6	
Death	.1	.1	.1	
Behavior disorder ^b	2.1	2.4	4.1	
Personality disorder ^b	8.2	11.7	18.7	
Sexual disorder ^c	.5	1.3	1.3	
Punitive ^f	3.3	2.4	4.2	157.71***
Discharges due to misconduct (%) ^b	6.8	8.4	15.6	82.86***
Discharges due to drug use (%) ^b	1.4	3.5	7.3	92.31***
Discharges due to pregnancy (%)	3.9	5.3	5.2	ns
Severity of loss score ^e	347.2 (177.7)	363.7 (185.2)	413.6 (209.4)	56.90***

^a Daily smokers significantly different from other two categories

^b Daily smokers significantly different from Never smokers

^c Never smokers significantly different from other two categories

^d Never smokers significantly different from Other smokers

^e All groups different

^f Daily smokers significantly different from Other smokers

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Note. n's for this table ranged from 5,281 to 5,438.

With regard to the specific groupings of reasons for discharge, two measures were statistically significant (Misconduct and Drug Use) and one was not (Pregnancy). Never smokers were significantly less likely than Daily smokers to be discharged due to misconduct or drug use. Pregnancy-related discharges, on the other hand, did not differ significantly among the three groups. All groups differed in their severity of loss scores. Daily smokers had the highest score, followed by Other smokers, and Never smokers had the lowest loss severity scores.

Table 3 presents performance-related variables by smoking category. In several analyses, time in service was used as a covariate because of its role as a confounder with other time-dependent outcomes measures, such as number of promotions during one's career. Number of promotions and number of unauthorized absences (UAs) did not differ significantly by smoking category after adjusting for time in service. However, the groups did differ in the number of demotions and desertions. Pair-wise contrasts using Never smokers as the reference group indicated that Never smokers had significantly fewer demotions and desertions than Daily smokers. Other smokers did not differ significantly from Never smokers. Because demotions, UAs, and desertions were relatively rare events with highly skewed distributions, the analyses were repeated after transforming those outcomes to natural logs. The results were essentially the same as those with non-transformed data.

A significantly higher percentage of Never smokers than Daily smokers had ever been recommended for reenlistment, and had actually reenlisted subsequent to the first enlistment. Other smokers were intermediate on the two reenlistment variables, but were not significantly different than the other two groups. With regard to the highest paygrade earned during their enlistment, all three groups were significantly different from one another. Never smokers had the highest mean paygrade level, followed by Other smokers, and then Daily smokers. There were not

significant differences among the three smoking groups in the percent that earned officer status during their careers.

Table 3
Comparison of Smoking Groups on Performance-related Outcomes

Performance Variable	Mean (SD/SE) or %			F or χ^2
	Never Smoker	Other Smoker	Daily Smoker	
No. of promotions adj. for Time in Service (TIS)	2.20 (.022)	2.22 (.027)	2.17 (.027)	ns
No. of demotions adj. for TIS ^b	.070 (.006)	.080 (.008)	.103 (.008)	5.73**
No. of UAs adj. for TIS	.025 (.004)	.018 (.005)	.034 (.005)	ns
No. of desertions adj. for TIS ^b	.009 (.003)	.012 (.003)	.024 (.003)	6.99***
Recommended for reenlistment (%) ^b	82	78	69	89.20***
Percent reenlisted ^b	33	26	21	65.23***
Highest paygrade achieved ^{e,g}	4.05 (1.05)	3.95 (1.10)	3.69 (1.18)	44.98***
Officer accession (%)	0.9	0.9	0.4	ns

^a Daily smokers significantly different from other two categories

^b Daily smokers significantly different from Never smokers

^c Never smokers significantly different from other two categories

^d Never smokers significantly different from Other smokers

^e All groups different

^f Daily smokers significantly different from Other smokers

^g A paygrade value of 4 is equivalent to a 3rd Class Petty Officer.

* $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$

Note. n's for this table ranged from 4,860 to 5,448.

Discussion

To our knowledge, no previous study has examined an all-female cohort entering a branch of the U.S. military to examine whether cigarette smoking prior to entering the military would prospectively predict subsequent career performance. Comparisons among groups defined by self-reported smoking just prior to entering the U.S. Navy indicated a consistent pattern of results. Compared to Never smokers, Daily smokers at entry into the Navy were subsequently more likely to have poorer outcomes on a wide variety of Navy career indicators. Daily smokers were more likely than Never smokers to sign up for shorter-term enlistments, leave the Navy prior to serving a full-term enlistment (i.e., early attrition), and spend less overall time in naval service. Daily smokers also were more likely to receive less-than-honorable discharges, more misconduct (e.g., behavioral, personality, sexual, drug-related, and punitive) discharges, more demotions and desertions, achieved a lower final paygrade, be less likely recommended for reenlistment, and less likely actually to reenlist. The category of Other smokers (i.e., had smoked, but not daily at entry into the Navy) consistently fell between Never and Daily smokers on career outcome measures.

Findings from this study provide a greater understanding of the relationship between smoking and military service-related outcomes among Navy women. Such understanding is important as women are a significant source of personnel strength in the U.S. Navy, with about 59,000 women currently serving. Women are integrated into combat roles, the majority of Navy jobs are open to women, and women are expected to continue to comprise a significant portion of U.S. Navy personnel. As the numbers and opportunities expand for Navy women, a better understanding of the relationships among health, lifestyle, and job performance in women will become increasingly important.

Prior to this study, some information was available on the effects of smoking on military performance, costs, attrition, and service members' health; however, there were important gaps in the knowledge base. For example, previous relevant studies have analyzed data from branches of the armed services other than the Navy, extrapolating findings to Navy personnel rather than assessing them directly.¹⁵ Also, most previous studies focused on smoking as a predictor of a single or few outcomes, such as excess training costs or absenteeism, or measured relatively short-term outcomes of smoking (e.g., attrition during the first year of enlistment).¹⁵⁻¹⁷ Little was known about the association of smoking with *longer-term* personnel outcomes, such as career advancement, disciplinary problems, and reenlistment decisions. Most previous studies have been descriptive, ecological, or based on aggregated data, limiting the ability to make prospective inferences about smoking as a risk factor for subsequent personnel-related outcomes. Finally, military *women* often are not included in previous studies, or their smoking and outcome data are combined with men's and not presented separately. Recent studies suggest that smoking initiation, smoking maintenance, cessation experiences, relapse patterns, and even biological and genetic sensitivity to the damaging effects of smoking may be different for women and men.³¹⁻³⁴ Thus, it was important to examine the association of smoking with subsequent personnel and job-related outcomes separately for women.

The findings from this study have implications for additional research. As a group, Daily smokers at entry into the Navy consistently had the poorest performance outcomes during their time in the service when compared to Never or Other smokers. While Never smokers typically had the best performance outcomes, Other smokers generally fell in between Never and Daily smokers. This general trend suggests that entering the Navy as a less regular smoker, rather than a Daily smoker, is likely to be associated with better career outcomes. An interesting empirical

question is whether an intervention to help daily smokers either reduce their smoking to non-daily or become former smokers *prior* to entering the Navy could have an impact on subsequent career outcomes. The Delayed Entry Program (DEP), in which many recruits participate prior to entry into the Navy, could provide an ideal opportunity for smoker-enlistees to take part in smoking cessation programs. Future research should evaluate the impact of smoking cessation intervention prior to entering the Navy to determine whether this can improve subsequent career outcomes.

Competing interest statement. None of the authors have any competing interests concerning this research or this manuscript.

Ethics approval. All procedures used in this research were approved by the Institutional Review Boards at both San Diego State University and Naval Health Research Center, San Diego.

Copyright: The Corresponding Author has the right to grant on behalf of all authors and does grant on behalf of all authors, an exclusive licence (or non exclusive for government employees) on a worldwide basis to the BMJ Publishing Group Ltd to permit this article (if accepted) to be published in TC and any other BMJ PGL products and sublicences such use and exploit all subsidiary rights, as set out in our licence ([http://tc.bmjournals.com/misc/ifora/licence form.shtml](http://tc.bmjournals.com/misc/ifora/licence_form.shtml)).”

References

- 1 **American Cancer Society.** *Cancer Facts & Figures*, 2005.
- 2 **U.S. Department of Health and Human Services (USDHHS).** *Reducing the health consequences of smoking: 25 years of progress. A report of the Surgeon General.* U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 1989.
- 3 **U.S. Department of Health and Human Services (USDHHS).** *The health consequences of using smokeless tobacco. A report of the advisory committee to the Surgeon General, (1986).* U.S. Department of Health and Human Services, Public Health Service Publication No. 86-28774, 1986.
- 4 **U.S. Department of Health and Human Services (USDHHS).** *The health consequences of involuntary smoking. A report of the Surgeon General.* U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control. DHHS Publication No. (CDC) 87-8398, 1986.
- 5 **Eriksen MP, LeMaistre CA, Newell GR.** Health hazards of passive smoking. *Annual Review of Public Health* 1988;**9**: 47-70.
- 6 **Environmental Protection Agency (EPA).** *Respiratory health effects of passive smoking: Lung cancer and other disorders.* NIH Publication No. 93-3605. Washington DC: Office of Health and Environmental Assessment, 1993.
- 7 **Warner KE, Hodgson TA, Carroll CE.** Medical costs of smoking in the United States: estimates, their validity, and their implications. *Tobacco Control* 1999;**8**:290-300.
- 8 **Helyer AJ, Brehm WT, Perino L.** Economic consequences of tobacco use for the Department of Defense, 1995. *Military Medicine* 1998;**163**:217-221.
- 9 **Centers for Disease Control (CDC).** Annual smoking-attributable mortality, years of potential life lost, and economic costs—United States, 1995-1999. *MMWR Morb Mortal Wkly Rep* 2002;**51**(14): 300-303.
- 10 **Bray RM, Hourani LL, Rae KL, et al.** *2002 Department of Defense survey of health related behaviors among military personnel: final report* (prepared for the Assistant Secretary of Defense [Health Affairs], U.S. Department of Defense, Cooperative Agreement No. DAMD17-00-2-0057, RTI/7841/006-FR). Research Triangle Park, NC: RTI International, 2003.
- 11 **Conway TL.** Tobacco use and the United States military: a longstanding problem. *Tobacco Control* 1998;**7**:219-221.

- 12 **Woodruff SI**, Conway TL, Edwards CC, Elder JP. The United States navy attracts young women who smoke. *Tobacco Control* 1999;**8**:222-223.
- 13 **Kroutil LA**, Bray RM, Marsden ME. Cigarette smoking in the U.S. military: Findings from the 1992 Worldwide Survey. *Preventive Medicine* 1994;**23**:521-528.
- 14 **Conway TL**, Cronan TA. Smoking and physical fitness among Navy shipboard personnel. *Military Medicine* 1988;**153**(11):589-594.
- 15 **Klesges RC**, Haddock CK, Chang CF, Talcott GW, Lando HA. The association of smoking and the cost of military training. *Tobacco Control* 2001;**10**:43-47.
- 16 **Larson GE**, Kewley SB. *First-term attrition in the Navy: causes and proposed solutions* (NHRC Report No. 00-27). San Diego, CA: Naval Health Research Center, 2000.
- 17 **Zadoo V**, Fengler S, Catterson M. The effects of alcohol and tobacco on troop readiness. *Military Medicine* 1993;**158**:480-484.
- 18 **Blake GH**, Parker JA. Success in combat training: The role of cigarette smoking. *Journal of Occupational Medicine* 1991;**33**:688-690.
- 19 **Conway TL**, Cronan TA. Smoking, exercise, and physical fitness. *Preventive Medicine* 1992;**21**(6):723-734.
- 20 **Bahrke MS**, Baur TS, Poland DF, Connors DF. Tobacco use and performance on the U.S. Army physical fitness test. *Military Medicine* 1988;**153**:229-235.
- 21 **Feigelman W**. Cigarette smoking among former military service personnel: A neglected social issue. *Preventive Medicine* 1994;**23**:235-241.
- 22 **Klevens RM**, Giovino GA, Peddicord JP, et al. The association between veteran status and cigarette-smoking behaviors. *American Journal of Preventive Medicine* 1995;**11**(4): 245-250.
- 23 **Laurence JH**, Naughton J, Harris DA. *Attrition revisited: identifying the problem and its solutions* (ARI Research Note 96-20). Alexandria, VA: Army Research Institute, 1996.
- 24 **Conway TL**, Woodruff SI, Edwards CC, et al. Operation Stay Quit: evaluation of two smoking relapse prevention strategies for women after involuntary cessation during U.S. navy recruit training. *Military Medicine* 2004;**169**(3):236-242.
- 25 **Bray RM**, Marsden ME, Peterson MR. Standardized comparisons of the use of alcohol, drugs, and cigarettes among military personnel and civilians. *Am J Public Health* 1991;**81**(7):865-869.

- 26 **Stanton WR**, McClelland M, Elwood C, Ferry D, Silva PA. Prevalence, reliability and bias of adolescents' reporting of smoking and quitting. *Addiction* 1996;**91**(11): 1705-1714.
- 27 **Becker DM**, Conner HF, Waranch HR, et al. The impact of a total ban on smoking in the Johns Hopkins Children's Center. *J Am Med Assoc* 1989;**262**(6):799-802.
- 28 **Cronan TA**, Conway TL, Kaszas SL. Starting to smoke in the Navy: when, where and why? *Soc Sci Med* 1991;**33**(12):1349-1353.
- 29 **Gunderson EKE**, Garland CF, Miller MR, Gorham ED. Career history archival medical and personnel system. *Military Medicine* 2005;**170**:172-175.
- 30 **Agresti A**. *An introduction to categorical data analysis*. John Wiley & Sons, Inc: New York, 1996.
- 31 **Li MD**, Cheng R, Ma JZ, Swan, GE. A meta-analysis of estimated genetic and environmental effects on smoking behavior in male and female adult twins. *Addiction* 2003;**98**(1):23-31.
- 32 **Centers for Disease Control (CDC)**. Women and smoking: a report of the Surgeon General. Executive summary. *MMWR* 2002;**51**(RR-12):i-iv:1-13.
- 33 **Prescott E**, Osler M, Anderson PK, et al. Mortality in women and men in relation to smoking. *International Journal of Epidemiology* 1998;**27**:27-32.
- 34 **Langhammer A**, Johnsen R, Holmen J, Gulsvik A, Bjermer L. Cigarette smoking gives more respiratory symptoms among women than among men. The Nord-Trøndelag Health Study (HUNT). *Journal of Epidemiology and Community Health* 2000;**54**(12):917-22.