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Abstract

Background. The proportion of women in the military is increasing and they are being selected into jobs that are more combat-related. However, the mental health effects of working in combat support occupations among military women have not been previously evaluated.

Methods. Active-duty enlisted Navy and Marine Corps women in combat support ($N = 10,299$) and non-combat support occupations ($N = 63,478$) were followed for 2 years between January 1, 1994, and August 31, 2001. Hospitalization diagnoses were examined and organized into 8 categories of mental disorders; Cox proportional hazards modeling was used to describe these outcomes.

Results. Women in combat support occupations were found to be significantly less likely to be hospitalized for a mental disorder than women in all other military occupations.

Conclusions. These results are reassuring but may be confounded by a healthy worker effect. Further studies are needed to assess how exposure to combat support occupations affects the long-term health of US military women.

In 1967, removal of the 2% limit on female representation in the US military allowed many more women to enlist in military service.^{1,2} By 2001, female representation in the US military had increased to 15% of the active-duty enlisted force.¹⁻³ As the number of women within the military grew, so did the diversity of occupations available to them.⁴ In 2001, administration and health care continued to account for the majority of female occupations, but the number of women working in traditionally male fields had increased dramatically.^{2,5} This increase was due in part to the National Defense Authorization Act of 1994, which opened over 80,000 new occupations to women.^{3,5-7} Shortly after this act was implemented, the Secretary of Defense rescinded the Risk Rule of 1988, which had prohibited women from working in occupations where there existed a “risk of exposure to direct combat, hostile fire or capture.”^{3,5,6} As a result of this act and other similar legislation, women were eligible to work in all military occupational areas, aside from direct ground combat.^{1,5,6}

As the number of opportunities for female military personnel increases and greater numbers of women are stationed in combat support units,^{3,5,7,8} the physical and mental stress faced by women serving in the US military continues to evolve. Some studies have indicated that approximately 6 to 20% of active-duty military personnel meet the clinical criteria for a mental disorder, with lifetime prevalence estimates of approximately 40%.⁹⁻¹² Other studies have demonstrated associations between certain occupations and the development of mental health disorders.¹³⁻¹⁷ Maintaining sound mental health of all women in the military is one of the primary goals of military medicine.^{9,18} This goal is even more important for those women working in combat support positions, where they must be prepared to work in highly stressful and traumatic situations.^{19,20} The sound mental health of women working in combat support occupations must be established prior to their deployment or exposure to armed conflicts situations. This enhances their preparedness for deployment and ensures high performance rates,

high productivity, and low levels of attrition.^{10,21–28} The primary objective of this study was to develop a baseline assessment of the mental health of military women working in newly gender-integrated combat support occupations prior to the onset of the wars in Iraq and Afghanistan.

Materials and Methods

Study Population

The study population included active-duty enlisted women within the 4 lowest pay grades (E1–E4), who served for a minimum of 6 months in the US Marine Corps or US Navy between January 1, 1994, and August 31, 2001. The study period ending in 2001 was selected primarily to avoid possible confounding due to increases in armed combat experiences among women deployed to Iraq and Afghanistan,¹⁰ and secondarily to avoid any confounding associated with decline or changes in mental health problems among military personnel following September 11, 2001.²⁹

Active-duty enlisted women serving in the US Air Force and US Army were excluded from this study because they accounted for less than 3% of the total identifiable population of women in combat support occupations. Active-duty enlisted women in pay grades E5–E9 were excluded to avoid possible confounding associated with varying lengths of service in the military and an increased likelihood of migration between career fields. In addition, officers in the Navy and Marine Corps were excluded since they represent only a small percentage of the total population of active-duty women and are not comparable to enlisted women with respect to age, education level, and years in service.^{1,2} Female Reservists in the Navy and Marine Corps were excluded because they have limited access to Department of Defense (DoD) health care services.³⁰ Finally, any subject who was or became pregnant during the period of observation was excluded due to the potential association between pregnancy and certain mental disorders.^{31–}

The study population was categorized into 2 groups according to occupational exposure: enlisted women in combat support occupations and enlisted women in non-combat support occupations. Only women who worked in their occupational subgroup for a minimum of 6 months were included in the study. Individuals in both groups were followed for up to 2 years of service from the date of entrance in the specified occupational category.

Specific occupational codes were based on the Navy Enlisted Classification (NEC) for Navy service members and Military Occupational Specialty (MOS) for Marine Corps service members.³⁶ Occupational subgroups represent broader occupational categories that include one or more related MOS/NEC codes. The majority of occupations closed to women prior to January 1994 were restricted because of the possibility of exposure to combat.⁶ For the purpose of this study, we defined combat support occupations as any occupational subgroup in which an NEC or MOS was newly opened to women after January 1, 1994 (Table 1).

Data

Demographic data were obtained from the Defense Manpower Data Center, Seaside, California, which maintains up-to-date and historical rosters of all active-duty enlisted personnel. These rosters include gender, pay grade (E1–E4), race/ethnicity (white non-Hispanic, black non-Hispanic, Hispanic; other), service (Navy, Marine Corps), occupational subgroup, and other military-specific information. These data reflect the date of entrance into the occupational subgroup (i.e., the onset of the 2-year observation period).

Study Outcomes

All outcomes of interest were assessed only during the final 18 months of the 2-year period that each study subject was followed. The first 6 months of each individual's 2-year follow-up period was not assessed for outcomes to ensure that each subject had been in her

occupation for a minimum of 6 months. Subjects' primary hospitalization diagnoses were obtained from electronic DoD hospitalization data. Hospital diagnoses assigned an *International Classification of Diseases*, Ninth Revision, Clinical Modification (ICD-9-CM) code³⁷ were obtained from the Standard Inpatient Data Record and the Health Care Service Record, which are products of the Military Health System. All files were obtained in electronic format.

For each inpatient visit, up to 8 diagnoses were available. For the purpose of this study, we defined a mental health hospitalization to be any hospitalization in which the primary diagnosis, at the time of release from the hospital, was a mental disorder (ICD-9-CM codes 290-319). Further, we divided this broad category into eight diagnostic categories of mental disorders based on those specified by the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition.^{12,38}

Statistical Analyses

After descriptive investigation of population characteristics, analyses were performed to assess the significance of associations between mental health hospitalization and age, race/ethnicity, service, and pay grade. Cox's proportional hazards time-to-event modeling was employed to compare mental health hospitalizations among women in combat support occupations with women in non-combat support occupations, while accounting for attrition from active-duty service during the 18-month follow-up period. Follow-up time began 6 months after the date of entrance into the occupational subgroup for both combat support and non-combat support groups and continued for 18 months, or until a mental health hospitalization, or until attrition from active-duty service, whichever occurred first. Statistical analyses producing adjusted hazard ratios (HRs) and associated 95% confidence intervals (CIs) were performed using SAS® software (Version 9.0, SAS Institute, Inc., Cary, NC).³⁹⁻⁴²

Initial analyses indicated that age, military rank, past deployment status, race/ethnicity, service branch, and occupational category were significantly associated with mental health hospitalizations (p value ≤ 0.05). Education level was not found to be significantly associated with mental health hospitalization and therefore was not incorporated into the model. In addition, deployment data were only available for those women serving between 1998 and 2001 and therefore were not used in subsequent modeling.

Studies have indicated that married individuals are less likely to develop mental health problems when compared with unmarried individuals.⁴³ However, recent research has indicated that it is partnership, marriage or otherwise, that is protective against mental health disorders.⁴⁴ It has been reported that only 9% of first enlistments are married¹ and there are no available statistics on the relationship or partnership status of the remaining 91% of first enlistment women. In order to avoid the misclassifications associated with using marital status as a surrogate for partnership status in a population that is young and the majority of subjects are unmarried, marital status was not incorporated into the model. Therefore, the covariates entered into the Cox's proportional hazards model included race/ethnicity, age, pay grade, service, and occupation.

Results

Complete exposure and demographic data were available for 73,777 enlisted E1–E4 women serving for a minimum of 6 months in the Navy and Marine Corps between January 1, 1994, and August 31, 2001 (Table 2). Of these women, 47% were age 19 years or younger, 55% were white, 82% Navy, and 61% were in pay grades E1 and E2. Fourteen percent ($N = 10,299$) of subjects in the population worked in a combat support occupational subgroup.

Regression diagnostics to evaluate pairwise correlations and variance inflation factors indicated that there were no collinearities among the model variables. Mean follow-up time for

combat support and non-combat support occupations was 482 days and 483 days, respectively. Using Cox regression to simultaneously adjust for all variables in the model, results indicated that women working in combat support occupations (HR = 0.64, 95% CI = 0.53–0.77) were less likely to be hospitalized for a mental illness compared with women working in non-combat support occupations (Table 3). The cumulative probability plots of mental health hospitalization by occupational status remained stable through time. However, there was a notable divergence indicating an increase in the probability of mental health hospitalization over time for women in non-combat support occupations (Figure 1).

With regard to other covariates, older women were slightly more likely to have a mental health hospitalization compared with women in the youngest age category, ≤ 19 years (Table 3). White women were significantly more likely to have a mental health hospitalization when compared with black women (HR = 1.41, 95% CI = 1.24–1.60). In contrast to age, increasing pay grade was found to be associated with fewer mental health hospitalizations. Enlisted women in pay grades E3 and E4 were found to be less likely to have a mental health hospitalization when compared with women in pay grade E1 (Table 3).

Additional statistical modeling was performed for each of the major diagnostic categories for mental health disorders using women in non-combat support occupations as the reference group (Table 4). These analyses indicated a negative association between mental health hospitalization and combat support occupations for all categories of mental disorders, with the exception of mood disorders (HR = 1.18, 95% CI = 0.85–1.63), which were positively associated with combat support occupations but not to a statistically significant degree (Figure 2). The association between somatoform disorders and combat support occupations could not be analyzed because no women in the combat support occupations were hospitalized for this type of disorder during the time period of interest. The negative associations between combat support

occupations and the remaining 6 mental disorder categories varied in significance. Personality disorders, adjustment disorders, and substance abuse disorders were the most negatively associated with combat support occupations and were also found to be statistically significant (Table 4).

Discussion

The recent deployment of troops to Afghanistan and Iraq has heightened awareness of the mental health effects of combat on military servicemen and women. Hoge et al. recently described a relationship between combat experience and posttraumatic stress disorder among troops deployed to Iraq and Afghanistan.¹⁰ Like others, this work revealed a positive association between exposure to combat and mental health morbidity.^{10, 43, 45, 46} The particular effects of combat support occupations on women prior to combat exposure, however, have not been previously well described.

During the 18-month follow-up period, 1.3% of women in combat support occupations were hospitalized for a mental disorder, compared with 2.2% of women in non-combat support occupations. After adjusting for all other demographic variables, women in combat support occupations were significantly less likely to be hospitalized for a mental health disorder than women in all other occupations (HR = 0.6, 95% CI = 0.53–0.77).

One explanation for this seemingly “protective effect” is that women who choose to enter, or are selected to enter, combat support occupations are generally more physically and mentally fit than women in other military occupations. To assess this possibility, a Cox analysis was performed analyzing the effects of a combat support occupation on other causes of hospitalization (i.e., all those causes except pregnancy and mental health disorders). This analysis indicated that women in combat support occupations were less likely to be hospitalized for any reason when compared with women working in non-combat support occupations (HR =

0.55, 95% CI = 0.50–0.60). This finding suggests the possibility of a “healthy worker” or selection effect, which would support previous research that has indicated that people with mental health problems are more likely to have physical health problems as well.^{47–50}

Many studies have suggested that the fear of stigmatization limits the number of military service personnel who seek mental health care.⁹ According to Hoge et al., only 23-40% of servicemen and women with a mental disorder seek some form of mental health care.¹⁰ The pressure associated with serving in nontraditional occupations, such as combat support, may exacerbate the fear of stigmatization associated with seeking mental health services, making women in these occupations even less likely to seek mental health care. Alternatively, some studies have indicated that women working in nontraditional, male-dominated occupations have “more effective coping methods and experience less strain” when compared with women in traditional occupations.⁵¹

This study provides a preliminary look into the association between mental health disorders and combat support occupations among women in the Navy and Marine Corps. Further research is needed to understand the significance of these observations. For example, examination of the coping ability as well as the overall health status of women in combat support occupations should be compared with women in non-combat support occupations. Such research could help to explain whether women in combat support occupations are generally healthier or if they are simply less likely to seek health care services. Additional research examining the stigmatization associated with seeking mental health care, and how this fear of stigmatization varies among occupations, is also needed.

Younger, less educated, lower ranking female service members have been shown in several studies to be at a greater risk for mental health hospitalization.^{11,12,23,24,43,52,53} Our findings concerning the negative association between increasing ranks and mental health

hospitalizations was consistent with these previous studies. In contrast, we found younger age to be protective against mental health hospitalization. However, due to the relative homogeneity of our population with regard to age, we classified individuals into three very narrow categories (under 19, 20-22, and 23+); previous studies have used much broader categories for age.⁴³ Since 78% of our study population would be categorized into the lowest age category used in most studies, it would be inappropriate to compare their associations between age and mental health disorders with our study.

Analysis of categories of mental health hospitalizations among women in combat support and non-combat support occupations indicated that substance-related disorders, adjustment disorders, mood disorders, and personality disorders accounted for the greatest percentage of mental health hospitalizations. These results are in agreement with other studies on mental health disorders in the military.¹² Our analysis showed that all categories of mental health hospitalization with sufficient data, excluding mood disorders, were negatively associated with combat support occupations. The positive association between combat support occupations and mood disorders was not found to be statistically significant. However, this finding was particularly interesting considering the negative associations seen among all other categories of mental disorders. Further research may clarify if depression or other mood disorders are uniquely associated with combat support occupations in military women.

These analyses have a number of limitations that should be considered. A study period of only 2 years might not be long enough to adequately capture mental disorder hospitalizations associated with combat support occupations. The use of hospitalization as a measure of morbidity limits our investigation to only severe mental disorders and does not account for outpatient care. The population for this study accounted for only a subset of women working in combat support occupations and may not apply to other women in these same occupations, such

as officers, higher ranked enlisted women, and women serving in the Army and Air Force. Additionally, deployment data were not available for the entire time period of the study and were therefore not incorporated into the time-to-event modeling. Due to limitations in our data resources, we were unable to analyze subjects at the most specific occupation level. By using occupational subgroup as a surrogate for NEC/MOS, some subjects may have been nondifferentially misclassified in the exposure group, although this would likely bias our findings toward a null result.

Despite these limitations, our study had a number of strengths. Hospitalization data for active-duty military personnel are generally very complete. In addition, few active-duty personnel seek medical care outside of the DoD system.⁵⁴ The large study population provided adequate statistical power to detect even small differences, and proportional hazards modeling allowed for hazard ratio estimates while simultaneously adjusting for many covariates and varied length of follow-up.

In summary, we defined an objective measure of mental health morbidity among enlisted Navy and Marine Corps women in combat support and non-combat support occupations. Based on these data, women in combat support occupations were significantly less likely to be hospitalized for all mental disorders, substance-related disorders, adjustment disorders, and personality disorders when compared with women in non-combat support occupations. This study is the first to assess the effects of working in a combat support occupation on the mental health of US service women. Mental health morbidity continues to be a significant liability to the preparedness of the US military,¹⁰ both as a financial challenge because of attrition as well as a hindrance to satisfactory job performance.²¹⁻²⁸ Although further work is necessary to assess the significance of these results, this study suggests that prior to the commencement of wars in Iraq

and Afghanistan women working in combat support occupations were not at a higher risk for mental health problems when compared with women in other military occupations.

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TABLE 1

Occupational Subgroups Containing Newly Gender Integrated Combat Support Occupations, 1994–2001

Occupational Area	Occupational Subgroup
0 – Infantry, Gun Crew, and Seaman	Military Training Instructor
	Combat Engineering
	Artillery and Gunnery
	Pilots and Navigators
1 – Electronic Equipment Repairers	Radio/Radar General
	Communications Radio
	Surveillance/Target Acquisition and Tracking
	Radar
	Shipboard and Other Fire Control
	Missile Guidance and Control
	Sonar, General
ADP Computers	
2 – Communications and Intelligence Specialists	Sonar Operator General
	Radar and Air Traffic Control
	Analysis
4 – Other Technical and Allied Specialists	Ordinance Disposal and Diving
	Electronic Counter Measures

6 – Electrical/Mechanical Equipment

Repairers

General Aircraft

Aircraft Engines

Aircraft Launch Equipment

Auxiliaries

TABLE 2

Characteristics of Active-Duty Enlisted Navy and Marine Corps Women Working in Combat Support and Non-Combat Support Occupational Subgroups, 1994–2001

Variable	Combat			<i>P</i> Value*
	Population	Support	Non-Combat Support	
	(<i>N</i> = 73,777)	(<i>N</i> = 10,299)	(<i>N</i> = 63,478)	
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	
Age, years				
≤19	34,401 (46.6)	2,836 (27.5)	31,565 (49.7)	<0.0001
20-22	22,932 (31.1)	4,197 (40.8)	18,735 (29.5)	
≥23	16,444 (22.3)	3,266 (31.7)	13,178 (20.8)	

Race/Ethnicity

Black, non-Hispanic	19,141 (25.9)	1,989 (19.3)	17,152 (27.0)	<0.0001
White, non-Hispanic	40,758 (55.3)	6,405 (62.2)	34,353 (54.1)	
Hispanic	8,779 (11.9)	1,158 (11.2)	7,621 (12.0)	
Other	5,099 (6.9)	747 (7.3)	4,352 (6.9)	

Service

Marine Corps	13,387 (18.1)	925 (9.0)	12,462 (19.6)	<0.0001
Navy	60,390 (81.9)	9,374 (91.0)	51,016 (80.4)	

Military pay grade

E1	28,277 (38.3)	888 (8.6)	27,389 (43.1)	<0.0001
E2	17,191 (23.3)	1,987 (19.3)	15,204 (24.0)	
E3	17,837 (24.2)	4,250 (41.3)	13,587 (21.4)	
E4	10,472 (14.2)	3,174 (30.8)	7,298 (11.5)	

* *P* values based on Pearson chi-square test.

TABLE 3

Characteristics of Active-Duty Enlisted Navy and Marine Corps Women in Relation to Mental Health Hospitalization, 1994–2001

Variable	Hospitalized	Not Hospitalized	HR*	95% CI*
	<i>n (%) (N = 1,553)</i>	<i>n (%) (N = 72,224)</i>		
Occupation				
Non-combat support [†]	1,422 (91.6)	62,056 (85.9)	-	-
Combat support	131 (8.4)	10,168 (14.1)	0.64	(0.53, 0.77)
Age, years				
≤ 19 [†]	777 (50.0)	33,624 (46.6)	-	-
20-22	477 (30.7)	22,455 (31.1)	1.11	(0.98, 1.25)
≥ 23	299 (19.3)	16,145 (22.3)	1.21	(1.04, 1.41)

Race/Ethnicity

Black, non-Hispanic [†]	333 (21.4)	18,808 (26.0)	-	-
White, non-Hispanic	951 (61.3)	39,807 (55.1)	1.41	(1.24, 1.60)
Hispanic	163 (10.5)	8,616 (11.9)	1.06	(0.88, 1.28)
Other	106 (6.8)	4,993 (7.0)	1.19	(0.96, 1.48)

Service

Marine Corps [†]	313 (20.1)	13,074 (18.1)	-	-
Navy	1,240 (79.9)	59,150 (81.9)	0.97	(0.85, 1.10)

Military pay grade

E1 [†]	693 (44.6)	27,584 (38.2)	-	-
E2	413 (26.6)	16,778 (23.2)	0.97	(0.86, 1.10)
E3	326 (21.0)	17,511 (24.3)	0.77	(0.66, 0.89)
E4	121 (7.8)	10,351 (14.3)	0.49	(0.40, 0.61)

* HR = hazard ratio, CI = confidence interval.

[†] Reference group.

TABLE 4

Specific Mental Health Diagnoses Among Active-Duty Enlisted Navy and Marine Corps
Women Working in Combat Support and Non-Combat Support Occupational Subgroups, 1994-
2001

Diagnostic Category	Number of Hospitalizations			
	Combat Support	Non-Combat Support	HR [†]	95% CI [‡]
	<i>N</i> = 10,299 <i>n</i> (%)	<i>N</i> = 63,478 <i>n</i> (%) [*]		
All mental disorders				
290-319	131 (1.3)	1,422 (2.2)	0.64	(0.53–0.77)
Substance-related disorders				
291, 303, 305.0, 292 (except 292.2), 304, 305.2, 305.7, 305.9	20 (0.2)	245 (0.4)	0.56	(0.35–0.89)
Adjustment disorders				
309.0, 309.24, 309.28, 309.3, 309.4, 309.9	37 (0.3)	513 (0.8)	0.49	(0.35–0.69)
Mood disorders				
296.2, 296.3, 296.0, 296.4–296.7, 296.8, 296.89, 300.4, 311, 296.90, 301.13	48 (0.4)	275 (0.4)	1.18	(0.85–1.63)

Psychotic disorders				
295.1-295.3, 295.6, 295.7, 295.9, 295.4, 298.8, 298.9, 297.1, 297.3	5 (0.05)	35 (0.06)	0.82	(0.31–2.16)
Personality disorders				
301.0, 301.2, 301.4, 301.50, 301.6, 301.7, 301.81-301.84, 301.89, 301.9	18 (0.2)	313 (0.5)	0.45	(0.28–0.73)
Anxiety disorder				
300.01, 300.21, 300.02, 300.3, 300.22, 300.23, 300.29, 308.3, 309.81, 300	11 (0.1)	154 (0.2)	0.55	(0.29–1.04)
Somatoform/Factitious disorders				
300.12-300.15, 300.6, 300.16, 300.19, 300.11, 300.7, 300.81, 307.80, 307.89	0 (0.0)	6 (0.0)	-	-
Eating disorders				
307.1, 307.5	3 (0.03)	23 (0.03)	0.83	(0.24–2.94)

* Reference group.

† HR = adjusted hazard ratio (adjusted for age, race/ethnicity, service, and pay grade).

‡ CI = confidence interval.

FIGURE 1. Cumulative probability of mental health hospitalization, January 1, 1994, to August 31, 2001, among enlisted Navy and Marine Corps women by combat support occupation status.

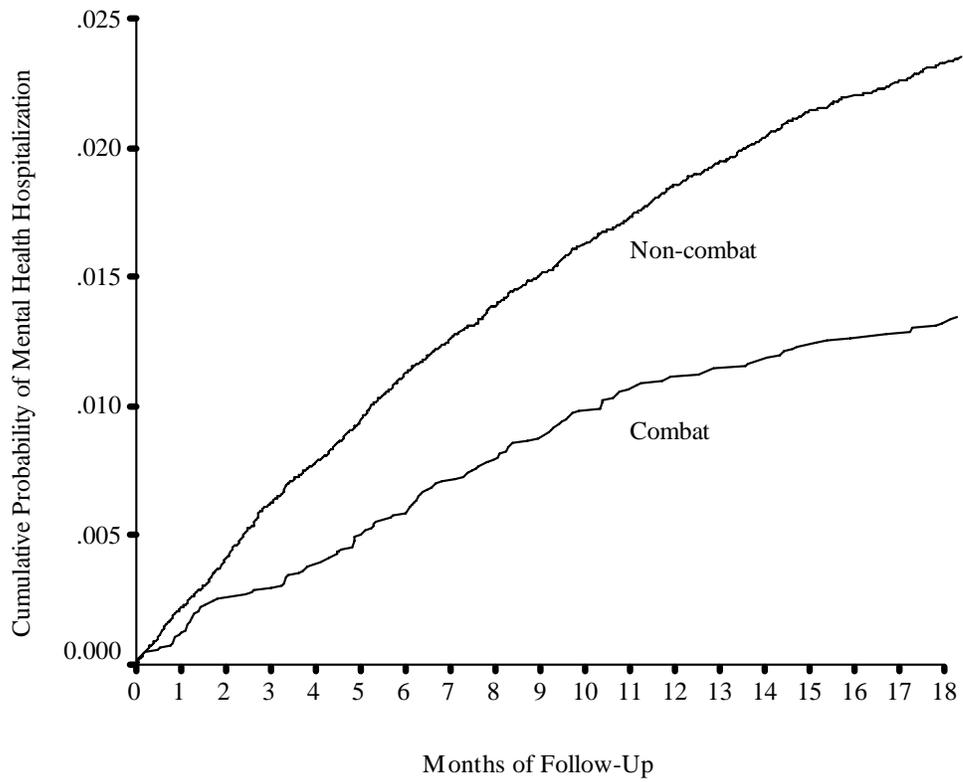
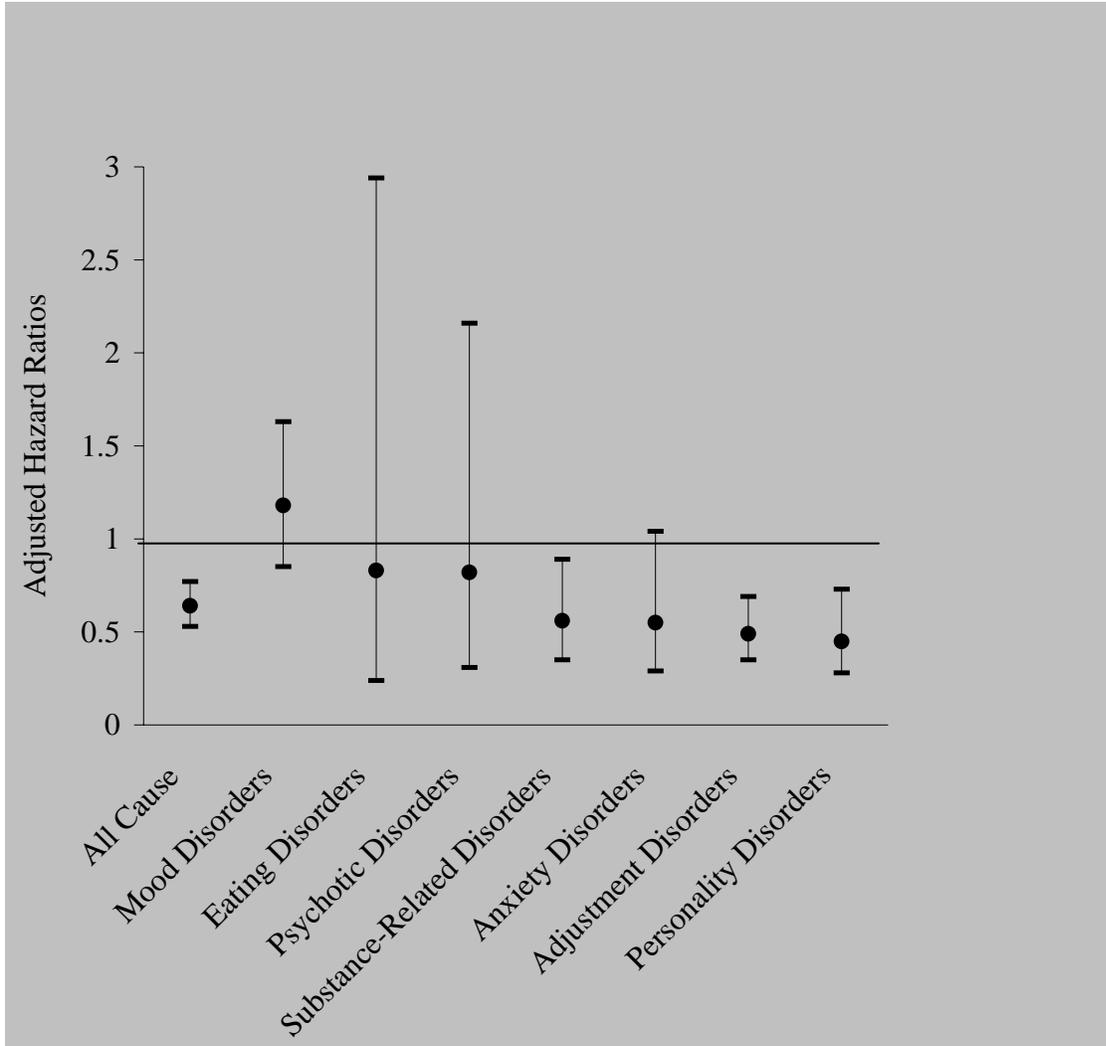


FIGURE 2. Adjusted hazard ratios and 95% confidence intervals of mental health hospitalizations among enlisted Navy and Marine Corps women working in combat support occupations compared with women working in non-combat support occupations, 1994–2001.



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13. SUPPLEMENTARY NOTES

14. ABSTRACT (maximum 200 words)

Since 1994, thousands of combat support occupations within the US military have been opened to women. The mental health effects of working in combat support occupations among military women have not been previously evaluated. Active-duty enlisted Navy and Marine Corps women in combat support ($N = 10,299$) and non-combat support occupations ($N = 63,478$) were followed for 2 years between January 1, 1994, and August 31, 2001. Military hospitalization diagnoses were examined and organized into 8 categories of mental disorders; Cox proportional hazards modeling was used to describe these outcomes. Women in combat support occupations were found to be significantly less likely to be hospitalized for a mental disorder than women in all other military occupations. These results are reassuring but may be confounded by a healthy worker effect. Further studies are needed to assess how exposure to combat support occupations affects the long-term health of US military women.

15. SUBJECT TERMS
mental health, occupational health, military medicine, women's health, combat neuroses

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