

NAVAL HEALTH RESEARCH CENTER

A COMPARISON OF THE POST-DEPLOYMENT HOSPITALIZATION EXPERIENCE OF US MILITARY PERSONNEL FOLLOWING SERVICE IN THE 1991 GULF WAR, SOUTHWEST ASIA AFTER THE GULF WAR, AND BOSNIA

***B. Smith
T. C. Smith
M. A.K. Ryan
G. C. Gray***

Report No. 04-25

Approved for public release; distribution unlimited.



**NAVAL HEALTH RESEARCH CENTER
P. O. BOX 85122
SAN DIEGO, CA 92186-5122**

**BUREAU OF MEDICINE AND SURGERY (M2)
2300 E ST. NW
WASHINGTON, DC 20372-5300**



**A Comparison of the Post-deployment Hospitalization Experience
of US Military Personnel Following Service in the 1991 Gulf War,
Southwest Asia After the Gulf War, and Bosnia**

Besa Smith, MPH

Tyler C. Smith, MS

Margaret A.K. Ryan, MD, MPH

Gregory C. Gray, MD, MPH *

DoD Center for Deployment Health Research
Naval Health Research Center
P.O. Box 85122
San Diego, CA 92186-5122

*Department of Epidemiology
College of Public Health at the University of Iowa
Iowa City, Iowa

Report No. 04-25, supported by the Department of Defense, under work unit no. 60002. The views expressed in this article are those of the authors and do not reflect the official policy or position of the Department of the Navy, Department of Defense, or the US Government. Approved for public release; distribution is unlimited. This research has been conducted in compliance with all applicable Federal Regulations governing the protection of human subjects in research (Protocol #31293).

Abstract

Much attention has been given to the impact of deployment upon the health of veterans from the first Gulf War. While differences in self-reported symptoms have been common, no specific exposures have been implicated. Some have suggested that stress from deployment is the chief cause for multi-symptom conditions among 1991 Gulf War veterans. We sought to examine the impact of large military deployments upon hospitalization experience. Hospitalization records from October 1, 1988 through December 31, 2000 were examined for all active duty personnel deployed exclusively to the Gulf War, Southwest Asia, or Bosnia. Cox's hazard modeling was used to model time until first post-deployment hospitalization, separation from active duty, or December 31, 2000, whichever occurred first, while controlling for influential covariates and temporal changes. As compared to Gulf War veterans (n=455,465), personnel deployed to Southwest Asia after the Gulf War (n=249,047) were at a slight increased risk of hospitalization (HR=1.05; 95% CI =1.02, 1.08). However, personnel deployed to Bosnia (n=44,341) were at decreased risk for any-cause hospitalization (HR=0.69; 95% CI =0.66, 0.72). While these findings do not fully explain the complexity of post-deployment health experiences, they do not support the theory of a unique illness in 1991 Gulf War veterans.

Introduction

Since the end of the 1991 Gulf War deployment period a great deal of national and international attention has been paid to the investigation of possible exposure-related postwar illnesses(1-7). Military personnel returning from the 1991 Gulf War have reported a wide range of symptoms including fatigue, cognition problems, and musculoskeletal conditions which some have suggested may be related to service in the Gulf (8-15). Etiologies for increased symptom reporting remain elusive and epidemiologic studies of 1991 Gulf War veterans have found no increased risk of morbidity among Gulf War veterans as measured by birth defects among live births in active duty members within 2 years of the Gulf War (16), hospitalizations in active duty members within 2 years of the Gulf War (17), hospitalizations among members who did not seek care at Department of Defense (DoD) treatment facilities (18), hospitalizations for select diagnoses (19), or mortality due to diseases (20-22). Additionally, epidemiologic investigations of the health impacts of specific war-time exposures among Gulf War veterans found no excess hospitalizations among those personnel possibly exposed to nerve agents released as a result of the US demolition of a munitions depot at Khamisiyah, Iraq (23-25), or for those personnel possibly exposed to the smoke from Kuwaiti oil well fires (25, 26). Additionally, other than reports of a possible neurological impairment syndrome among Gulf War Veterans (27-29), efforts to classify a group of symptoms as a unique Gulf War-related syndrome have not been successful (30-33).

Studies have indicated that life in the military is more psychologically and physically taxing than life in civilian society (34, 35). Researchers suggest that sudden and prolonged deployment, separation from family or home, irregular work hours, training involving strenuous physical and mental exertion, application of technologically advanced weaponry, threat of exposure to unknown chemical or biological agents, frequent family dislocation, and a number of personal stress factors (marital and other relationships) (36, 37) may be the cause of increased symptom reporting during and after deployment (38).

Immediately following the end of the Gulf War period, US military personnel were deployed for peacekeeping duty in Southwest Asia with operations extending throughout the 1990's. During this time, the US also deployed service members for peacekeeping duty in Bosnia. Reports have suggested that personnel involved in peacekeeping missions following wartime may have increased symptoms of psychological distress (39-44). Due to such

conditions as war zone stress, witnessing atrocities, frustrations with peacekeeping, and restrictive rules of engagement, peacekeepers may be at greater risks for posttraumatic stress disorder (39), disorders of extreme stress (45, 46), and self-inflicted injuries (47, 48). Others have found that soldier adaptation to isolation, ambiguity, powerlessness, boredom, and danger or threat, explains the degree of stress experienced (49). The purpose of this study was to compare the post-deployment hospitalization experiences of veterans from the 1991 Gulf War and personnel involved in the peacekeeping missions following the 1991 Gulf War.

Methods

Objectives

Specifically we sought to determine if differences existed in post-deployment hospitalization rates of 1991 Gulf War veterans, personnel deployed to Southwest Asia after the Gulf War, and personnel deployed to Bosnia. We analyzed hospitalization for any-cause, and hospitalization in each of the 14 broad ICD-9-CM categories. Secondary objectives included the identification of demographic risk factors associated with hospitalization during the period August 1, 1991 to December 31, 2000, and specific diagnoses of interest to Gulf War veterans.

Population

The study population consisted of regular active duty military personnel who served in one of the following deployments for 1 or more days during the deployment period: 1) the Gulf War theater August 1, 1990 to July 31, 1991 (n= 458,727), 2) Southwest Asia August 1, 1991 to December 31, 1998 (n= 254,080), and 3) Bosnia December 1, 1995 to December 31, 1998 (n= 46,911). Unlike Gulf War veterans, personnel were deployed multiple times to both Bosnia and Southwest Asia following the Gulf War. In order to compare similar populations, only single deployment personnel were included.

Demographic and deployment data were provided by the Defense Manpower Data Center, Monterey Bay, California. These data included a personal identifier (for linking purposes only), gender, marital status, service branch (Army, Navy, Marine Corps, Air Force, and Coast Guard), age (categorized by approximate quartile age groups: 17-22 years, 23-27 years, 28-33 years, and ≥ 34 years), combined race / ethnicity (White, Black, Hispanic, and other), DoD primary occupational specialty (10 major groups, defined by the DoD Occupational Conversion Manual) (50), pay grade (enlisted and officer), deployment location, entry and exit deployment dates,

basic active service date, and date of separation from military service. Demographic data reflected status as of the time of deployment.

Hospitalization Data

Electronic hospitalization data included date of admission and up to eight individual discharge diagnoses for each hospitalization. These data were captured from all DoD military treatment facilities worldwide during the period of October 1, 1988 through December 31, 2000. Data were linked to the deployment and demographic data using unique identifiers, and date of birth. Only hospitalization events during post-deployment were examined. Diagnoses were coded according to the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) (51). Additionally, as in previous reports (17, 23-26, 52-54) a pre-deployment hospitalization covariate was created to denote an individual's hospitalization for any-cause during the 12 months prior to their first deployment (55). These analyses did not consider the decimal component of the ICD-9-CM diagnoses; instead all diagnoses having the same whole numbers were considered the same. Electronic hospitalization data from hospitals outside the DoD system and outpatient data for the entire time period of this investigation were not available.

Study Outcomes

With a focus on the hospitalization experience as a whole, we sought to examine both hospitalizations due to all causes, and hospitalizations due to diagnoses in 14 broad ICD-9-CM diagnostic categories (51). The 14 broad ICD-9-CM categories of interest were: infection and parasitic diseases; neoplasms; endocrine, nutritional and metabolic diseases and disorders of the immune system; diseases of the blood and blood-forming organs; mental disorders; diseases of the nervous system and sense organs; diseases of the circulatory system; diseases of the respiratory system; diseases of the digestive system; diseases of the genitourinary system; diseases of the skin and subcutaneous tissue; diseases of the musculoskeletal system and connective tissue; symptoms, signs, and ill-defined conditions; and injury and poisoning. Additionally, we chose to analyze specific ICD-9-CM diagnoses that have previously been of concern to Gulf War veterans (19, 23, 28, 54, 56). These included the following conditions:

amyotrophic lateral sclerosis, asthma, diabetes, fibromyalgia, malignant neoplasms, mono-neuritis, muscular dystrophy, nephritis, rheumatoid arthritis, systemic lupus erythematosus, and testicular cancer.

Identification of any hospitalization occurring during the study period for the different deployment personnel was made using admission date, discharge date, discharge diagnoses, and deployment dates. The diagnostic fields were scanned in numerical order for the ICD-9-CM diagnoses of interest. Hospitalizations were scanned in chronological order, with only the first hospitalization occurring after deployment, and meeting the targeted outcome criteria, being retained as an event. Hospitalizations with ICD-9-CM diagnoses from the three diagnostic categories pertaining to pregnancy and childbirth were not included in this study.

Statistical Analysis

We compared the hospitalization experience of these three deployments by using Cox proportional hazards survival analysis modeling. This permitted us to control for delayed entry of personnel, as well as early exit, in the overall modeling time. Personnel were classified as having an event if they were hospitalized with the targeted outcome in any DoD military treatment facility worldwide. The up to 10 year follow-up period was calculated from the end of the first deployment until hospitalization, separation from active duty military service, or December 31, 2000, whichever occurred first. Univariate analyses were first performed to assess the significance of the demographic and deployment variables on the risk of any-cause hospitalization. The proportional hazards assumption was tested by visual inspection of cumulative distribution plots and tested by interaction terms between the main variables and time. An exploratory model analysis was performed to further assess demographic and deployment variables for significant associations and possible confounding while simultaneously adjusting for all other variables in the model. Using the SAS® system's data management and statistical capabilities (Version 9.0, SAS Institute, Cary, NC),(57) adjusted hazard ratios (HRs) and 95 percent confidence intervals (CIs) were calculated for deployment status and the significant demographic variables for these deployed groups.

Results

Complete deployment and demographic data were available for 455,465 active duty Gulf War veterans not deployed subsequently to Southwest Asia or Bosnia. During the 10 year 5 month observation period, separation from active duty service occurred in 95% of Gulf War veterans. There were more men (93.6%) than women, most were Army personnel (51.9%) followed by Navy/Coast Guard (21.8%), Marines (16.7%), and Air Force (9.6%). Most Gulf War veterans were younger than 27 years old (64.3%), 51.7% were married, 66.7% were white, and most (89.8%) were enlisted (table 1).

For active duty personnel deployed to Southwest Asia after the Gulf War and not deployed subsequently to Bosnia or previously to the Gulf War, we had complete deployment and demographic data for 249,047. During the 9 year 5 month observation period, separation from active duty service occurred in 66% of this group. There were more men (92.5%) than women, most were Navy/Coast Guard personnel (52.6%) followed by Air Force (26.6%), Army (12.3%), and Marines (8.5%). Most service members deployed to Southwest Asia were younger than 27 (65.3%), 44.7% were married, 74.2% were white, and most (89.5%) were enlisted (table 1).

Complete deployment and demographic data were available for 44,341 active duty personnel deployed to Bosnia but not previously deployed to the Gulf War or Southwest Asia after the Gulf War. During the 5 year 1 month observation period, separation from active duty service occurred in 46% of service members deployed to Bosnia. There were more men (88.6%) than women, most were Army personnel (75.8%) followed by Air Force (17.0%), Navy/Coast Guard (6.4%), and Marines (0.8%). Most personnel deployed to Bosnia were younger than 27 (66.1%), 49.1% were married, 66.4% were white, and most (88.9%) were enlisted (table 1).

Post-deployment hospitalizations occurred in 17.1 percent of the Gulf War veterans, 11.1 percent of the personnel deployed to Southwest Asia after the Gulf War, and 7.4 percent of the personnel deployed to Bosnia. Upon assessment of univariate analyses, we included the following variables in further multivariable modeling: gender, age, race/ethnicity, marital status, pay grade, length of service, pre-deployment hospitalization, service branch, and occupation. Collinearity diagnostics identified multi-collinearity between age, length of service, and pay grade, therefore length of service was removed from further modeling. Upon investigation of cumulative distribution plots and time interaction terms, we found evidence to suggest a violation of the proportional hazards assumption. Therefore, we included a time dependent

covariate to account for changes in hospitalization methods, diagnostic criteria, procedures and other time dependencies within the study period.

Evaluating adjusted risk of any-cause hospitalization by deployment revealed that, when compared with Gulf War veterans, service members deployed to Southwest Asia were at a slightly increased risk of hospitalization (HR=1.05; CI=1.02, 1.08), while those deployed to Bosnia were significantly less likely to be hospitalized (HR=0.69; CI=0.66, 0.72). Other significant findings included: women being at higher risk than men (HR=1.54; 95% CI=1.51,1.57), and an increasing risk for hospitalization with increasing age. Army personnel were at increased risk compared to Air Force (HR= 1.24; 95% CI=1.21, 1.26), whites were at slightly increased risk compared to blacks (HR= 1.05; 95% CI=1.03, 1.07), while Hispanics were at slightly decreased risk (HR= 0.91; 95% CI=0.88, 0.94). Those who were hospitalized prior to their deployment were at increased risk for hospitalization after their deployment (HR=1.67; 95% CI=1.64, 1.70). Finally, when we looked at occupation, health care workers (HR= 1.35; 95% CI=1.31, 1.39) were at the most elevated risk for hospitalization when compared to a referent category of workers (table 2).

Extended Cox time-to-event modeling was completed for each of 14 ICD-9-CM broad categories, with Gulf War veterans as the reference. Service members deployed to Southwest Asia after the Gulf War were more likely to be hospitalized for the majority of the broad ICD-9-CM categories. They were significantly more likely to be hospitalized for mental disorders (HR=1.34; 95%CI=1.26, 1.43), injury and poisoning (HR=1.12; 95%CI=1.06, 1.19), and diagnoses of the musculoskeletal system (HR=1.06; 95%CI=1.01, 1.12). Service members deployed to Bosnia were at significantly lower risk for hospitalization in all broad categories when compared with Gulf War veterans, with the exception of blood diseases (HR=0.93; 95% CI=0.75, 1.15) and mental disorders (HR=1.08; 95% CI=0.96, 1.21). They were least likely to be hospitalized for diseases of the skin (HR=0.57; 95% CI=0.46, 0.71), digestive system (HR=0.60; 95% CI=0.54, 0.67), genitourinary system (HR=0.60; 95% CI=0.51, 0.70), and neoplasms (HR=0.61; 95%CI=0.50, 0.76) (table 3).

Additional modeling of specific diagnoses of concern to Gulf War veterans is presented in table 4. Personnel deployed to Bosnia were significantly less likely to be hospitalized post-deployment for mononeuritis when compared to Gulf War veterans (HR=0.55; 95% CI=0.35,

0.88). No other specific diagnoses were found to be statistically significant. Due to sparse outcome data, measures could not be estimated for amyotrophic lateral sclerosis.

Discussion

A tremendous amount of research and resources have been spent investigating the health of 1991 Gulf War veterans since the war more than 14 years ago (2). Previous hospitalization studies have found no excess of unexplained hospitalization among Gulf War veterans (17, 18, 58), though association with service in the first Gulf War and some specific diagnoses have been reported (9, 10, 59). However, there has been some criticism regarding comparison of deployed personnel to those not deployed and what impact this ‘healthy deployer’ effect might have on results (60). Therefore, we compared 1991 Gulf War veterans to personnel deployed to the same geographic location immediately following the Gulf War, and personnel deployed to Bosnia during approximately the same time period. For any-cause hospitalization we found those deployed to Southwest Asia following the Gulf War to be at a significant increased risk for hospitalization, though the clinical significance of the point estimate (HR=1.05) is debatable. We also found those deployed to Bosnia to be at significantly reduced risk for any-cause hospitalization (HR=0.69) when compared to Gulf War veterans.

One possible explanation for the lower hazard ratios seen in those deployed to Bosnia is length of follow-up time. The follow-up time for service members deployed to Bosnia (5 years 1 month) was considerably less than that of Gulf War veterans (10 years 5 months), and personnel deployed to Southwest Asia after the Gulf War (9 years 5 months). It is arguable that relative risk estimates in the group deployed to Bosnia might approach those seen in personnel deployed to the Gulf War and Southwest Asia if a similar length of follow-up was allowed to see the same conditions manifest. This is most likely to affect modeling for long latency diseases, and although parameters to account for time dependencies were included, the differential follow-up may explain some of the reduced risk for diseases seen in those deployed to Bosnia. A slight elevation in risk for hospitalization seen in Gulf War veterans when compared to non-deployed personnel has been explained by higher rates of hospitalization both pre and post deployment. That is, lower rates of hospitalization during deployment increasing after troops return home is merely a regression to the mean induced by a selection effect and reduced accessibility to medical care during deployment (61). Brundage and colleagues describe a higher rate of in-

theater hospitalizations than post-deployment hospitalizations in personnel deployed to Bosnia (55, 62). If those deployed to Bosnia were more apt to seek care and be hospitalized during deployment, this may explain their reduced risk for post-deployment hospitalization, compared to Gulf War veterans.

Across the majority of the broad ICD-9-CM groups, our results show similar hospitalization rates between Gulf War veterans and service members deployed to Southwest Asia following the Gulf War, and lower hospitalization rates among personnel deployed to Bosnia. Although this may suggest that regional exposures, such as dust or sand fleas, may be responsible for these findings, with a particular exposure we would expect to see stronger measures of association within a particular diagnostic category (e.g. respiratory diseases; skin conditions) than in general across categories. Our findings do not suggest this. These findings more likely reflect differences in deployment with respect to differential follow-up, differential use of in-theater care, and subtle differences in deployed populations themselves that are unquantifiable.

On June 7, 1994, in response to health concerns of Gulf War veterans, the DoD established the Comprehensive Clinical Evaluation Program (CCEP) (52, 53). The program was initiated to offer a systematic medical evaluation to 1991 Gulf War veterans still on active duty at any of 184 medical treatment facilities worldwide. Out of concern that this systematic increase in health-seeking behavior specific to Gulf War veterans might affect the validity of our findings (54), we removed all individuals who had enrolled in the CCEP as of February 1997 (52), and re-analyzed our data. We found only a very small change in our measures of association that could not account for the lower risk for hospitalization in those deployed to Bosnia when compared with the 1991 Gulf War veterans (data not shown), therefore we included all data in these analyses.

Previous research has suggested that 1991 Gulf War veterans may be experiencing increased neurological symptoms and conditions (27-29, 63), however, our data suggest no difference in hospitalizations for diseases of the nervous system in those deployed to Southwest Asia after the Gulf War when compared to Gulf War veterans. Though personnel deployed to Bosnia did have reduced risk for hospitalizations in this category, we think it would be inappropriate to make any claims isolating their risk for hospitalization in a specific category when their risk is reduced across almost all major diagnostic categories. Additionally, our

investigation of specific diagnoses that have been of interest to Gulf War veterans did not find a statistically significant association other than the reduced risk of mononeuritis experienced by Bosnian deployed personnel when compared to Gulf War veterans. However, several of these illnesses are rare and/or have long latency, such that there was not enough time to observe the number of events needed to make statistical inferences between these deployed groups.

These analyses have a number of limitations that should be considered. The analysis of post-deployment morbidity was limited to outcomes severe enough to warrant hospitalization. Differences in self-reporting of symptoms which have been documented elsewhere (9, 11, 13-15), were not considered in this analysis. In addition, only regular active duty personnel were included as military hospitalization data were only available electronically for these personnel. Although US Reserve and National Guard forces played a large role in the successes of these deployments, these personnel are generally not hospitalized in military facilities once they return to civilian life after deployment, and therefore, were not included in this investigation.

We defined our theater cohorts to include active duty members who were deployed exclusively to only one of the three theaters: 1991 Gulf War, Southwest Asia after the Gulf War, and Bosnia. We believed it would be difficult to classify those individuals who served in more than one theater without suffering unquantifiable misclassification bias. It is possible these restrictions prevented the healthiest members, those with frequent multiple deployments, from being in our study. In addition, this study did not take into account deployments to other regions. Despite these limitations, our study has a number of strengths. Regular active duty personnel have ready access to medical care and are seldom hospitalized outside DoD facilities (17, 61) affording us the opportunity to capture a thorough view of the hospitalization events for this population. Cox's proportional hazard modeling allowed us to estimate relative risks in the presence of many covariates and varying follow-up time. The adequate sample size afforded us robust estimations, with the exception of some of the specific diagnoses, which were not our primary focus.

In summary, we found personnel deployed to Southwest Asia after the 1991 Gulf War to be at a slight increased risk for any-cause hospitalization and 3 of the 14 major diagnostic categories when compared to veterans of the 1991 Gulf War. We also found personnel deployed to Bosnia to be at a decreased risk for any-cause hospitalization and 12 of the 14 major diagnostic categories when compared to Gulf War veterans. This suggests that while risk for hospitali-

zation may be associated with regional deployment, it is unlikely that Gulf War veterans are at greater risk of hospitalization due to a specific exposure related disease. These findings demonstrate that we are yet to fully understand the health impact of military deployments upon healthcare utilization. Future studies, especially well-designed prospective studies, such as the Millennium Cohort Study (64), will better quantify deployment related morbidity in the US military.

ACKNOWLEDGMENTS

We thank Michael A. Dove, Scott L. Seggerman, and Gina Marchi from the Management Information Division, Defense Manpower Data Center, Seaside, California, for providing deployment data. We also thank Dr. Michael Kilpatrick from the Deployment Health Support Directorate (formerly Office of Special Assistant for Gulf War Illnesses). In addition, we wish to appreciate the support of Dr. Gary Gackstetter and Dr. Tomoko Hooper of the Uniformed Services University of Health Sciences, Bethesda, Maryland, and the support of the Henry M. Jackson Foundation for the Advancement of Military Medicine, Rockville, Maryland.

Corresponding author: Besa Smith, telephone (619) 553-7603; fax (619) 553-7601; email: besa@nhrc.navy.mil

References

1. Persian Gulf Veterans Coordinating Board. Unexplained illnesses among Desert Storm veterans: a search for causes, treatment, and cooperation. Report of the Persian Gulf Veterans Coordinating Board. Arch Intern Med 1995;155:262-268.
2. The Research Working Group of the Persian Gulf Veterans Coordinating Board. Annual report to Congress: Federally sponsored research on Gulf War veterans' illnesses for 2001. June 2002.
3. Presidential Advisory Committee on Gulf War Veterans' Illnesses. Presidential Advisory Committee on Gulf War Veterans' Illnesses : interim report. [Washington, D.C.]: The Committee : For sale by the U.S. G.P.O. Supt. of Docs.; 1996.
4. Institute of Medicine. Health Consequences of Service During the Persian Gulf War: Initial Findings and Recommendations for Immediate Action. Washington, DC: National Academy Press; 1995.
5. Goss Gilroy Inc. *Health study of Canadian forces personnel involved in the 1991 conflict in the Persian Gulf Vol I*. Ottawa, Ontario: Gos Gilroy Inc.; 1998 April 20.
6. Coker WJ, Bhatt BM, Blatchley NF, Graham JT. Clinical findings for the first 1000 Gulf war veterans in the Ministry of Defence's medical assessment programme. BMJ 1999;318(7179):290-4.
7. Sim M, Abramson M, Forbes A, Glass D, Ikin J, Ittak P, et al. Australian Gulf War Veterans' Health Study. In: Commonwealth Department of Veterans' Affairs, Australia; 2003. p. Australia, 2003:ISBN 1 920720 19 7 Online Version.
8. Malone JD, Paige-Dobson B, Ohl C, DiGiovanni C, Cunnion S, Roy MJ. Possibilities for unexplained chronic illness among reserve units deployed in Operation Desert Shield/Desert Storm. South Med J 1996;89:1147-1155.
9. Kroenke K, Koslowe P, Roy M. Symptoms in 18,495 Persian Gulf War veterans. Latency of onset and lack of association with self-reported exposures.[comment]. J Occup Environ Med 1998;40(6):520-8.
10. Joseph SC, Blanck R, Gackstetter GD, et al. A comprehensive clinical evaluation of 20,000 Persian Gulf War veterans. Mil Med 1997;162:149-155.

11. Fukuda K, Nisenbaum R, Stewart G, Thompson W, Robin L, Washko R, et al. Chronic multisymptom illness affecting Air Force veterans of the Gulf War. *JAMA* 1998;280:981-988.
12. The Iowa Persian Gulf Study Group. Self-reported illness and health status among Persian Gulf War veterans: A population-based study. *JAMA* 1997;277(3):238-245.
13. Gray GC, Reed RJ, Kaiser KS, Smith TC, Gastanaga VM. The Seabee Health Study: self-reported multi-symptom conditions are common and strongly associated among Gulf War veterans. *Am J Epidemiol* 2002;155:1033-1044.
14. Barrett DH, Gray GC, Doebbeling BN, Clauw DJ, Reeves WC. Prevalence of symptoms and symptom-based conditions among Gulf War veterans: current status of research findings. *Epidemiol Rev* 2002;24(2):218-27.
15. Gray GC, Gackstetter GD, Kang HK, Graham JT, Scott KC. After more than 10 years of Gulf War veteran medical evaluations, what have we learned? *J Prev Med* (in press).
16. Cowan DN, Gray GC, DeFraites RF. Birth defects among children of Persian Gulf War veterans. *N Engl J Med* 1997;337:1175-1176 letter.
17. Gray GC, Coate BD, Anderson CM, Kang HK, Berg SW, Wignall FS, et al. The postwar hospitalization experience of U.S. veterans of the Persian Gulf War. *N Engl J Med* 1996;335(20):1505-1513.
18. Gray GC, Smith TC, Kang HK, Knoke JD. Are Gulf War veterans suffering war-related illnesses? Federal and civilian hospitalizations examined, June 1991 to December 1994. *Am J Epidemiol* 2000;151(1):63-71.
19. Smith TC, Gray GC, Knoke JD. Is systemic lupus erythematosus, amyotrophic lateral sclerosis, or fibromyalgia associated with Persian Gulf War service? An examination of Department of Defense hospitalization data. *Am J Epidemiol* 2000;151(11):1053-1059.
20. Kang HK, Bullman T. Mortality among US veterans of the Persian Gulf War. *N Engl J Med* 1996;335(20):1498-1504.
21. Writer JV, DeFraites RF, Brundage JF. Comparative mortality among US military personnel in the Persian Gulf region and worldwide during Operations Desert Shield and Desert Storm. *JAMA* 1996;275(2):118-121.
22. Kang HK, Bullman TA, Macfarlane GJ, Gray GC. Mortality among US and UK veterans of the Persian Gulf War: a review. *J Occup Environ Med* 2002;59(12):794-9.

23. Gray GC, Smith TC, Knoke JD, Heller JM. The postwar hospitalization experience of Gulf War Veterans possibly exposed to chemical munitions destruction at Khamisiyah, Iraq. *Am J Epidemiol* 1999;150(5):532-40.
24. Smith TC, Gray GC, Weir JC, Heller JM, Ryan MAK. Gulf War veterans and Iraqi nerve agents at Khamisiyah. Postwar hospitalization data revisited. *Am J Epidemiol* 2003;158:456-467.
25. Smith TC, Corbeil TE, Ryan MAK, Heller JM, Gray GC. In-theater hospitalizations of US and allied personnel during the 1991 Gulf War. *Am J Epidemiol* 2004;159(11):1064-1076.
26. Smith TC, Heller JM, Hooper TI, Gackstetter GD, Gray GC. Are veterans of the Gulf War experiencing illness from exposure to Kuwaiti oil well fire smoke? Department of Defense hospitalization data examined. *Am J Epidemiol* 2002;155(10):908-917.
27. Kang HK, Mahan CM, Lee KY, Murphy FM, Simmens SJ, Young HA, et al. Evidence for a deployment-related Gulf War syndrome by factor analysis. *Arch Environ Health*. 2002;57(1):61-8.
28. Horner RD, Kamins KG, Feussner JR, Grambow SC, Hoff-Lindquist J, Harati Y, et al. Occurrence of amyotrophic lateral sclerosis among Gulf War veterans.[see comment]. *Neurology* 2003;61(6):742-9.
29. Haley RW. Excess incidence of ALS in young Gulf War veterans.[see comment]. *Neurology* 2003;61(6):750-6.
30. Ismail K, Everitt B, Blatchley N, Hull L, Unwin C, David A, et al. Is there a Gulf War syndrome? *Lancet* 1999;353(9148):179-82.
31. Knoke JD, Smith TC, Gray GC, Kaiser KS. Factor analysis of self-reported symptoms: Does it identify a Gulf War syndrome? *Am J Epidemiol* 2000;152(4):379-388.
32. Doebbeling BN, Clarke WR, Watson D, Torner JC, Woolson RF, Voelker MD, et al. Is there a Persian Gulf War syndrome? Evidence from a large population-based survey of veterans and nondeployed controls. *Am J Med* 2000;108(9):695-704.
33. Shapiro SE, Lasarev MR, McCauley L. Factor analysis of Gulf War illness: What does it add to our understanding of possible health effects of deployment? *Am J Epidemiol* 2002;156(6):578-584.
34. Segal M, Harris J. What we know about Army families. Special Report 21. Alexandria, VA: US Army Research Institute of the Behavioral and Social Sciences; 1993.

35. Pierce M, Luchsinger M. Psychological distress among Air Force wives. Colorado Springs, CO: US Air Force Academy; 1986.
36. Black Jr WG. Military-induced family separation: a stress reduction intervention. *Soc Work* 1993;38(3):273-280.
37. Schumm WR, Bell DB, Gade PA. Effects of a military overseas peacekeeping deployment on marital quality, satisfaction, and stability. *Psychological Reports* 2000;87(3 Pt 1):815-21.
38. Stuart JA, Halverson RR. The psychological status of US Army soldiers during recent military operations. *Mil Med* 1997;162(11):737-743.
39. Litz BT, Orsillo SM, Friedman M, Ehlich P, Batres A. Posttraumatic stress disorder associated with peacekeeping duty in Somalia for U.S. military personnel.[see comment][erratum appears in *Am J Psychiatry* 1997 May;154(5):722]. *Am J Psychiatry* 1997;154(2):178-84.
40. Orsillo SM, Roemer L, Litz BT, Ehlich P, Friedman MJ. Psychiatric symptomatology associated with contemporary peacekeeping: an examination of post-mission functioning among peacekeepers in Somalia [In Process Citation]. *J Trauma Stress* 1998;11(4):611-25.
41. Thoresen S, Mehlum L, Moller B. Suicide in peacekeepers--a cohort study of mortality from suicide in 22,275 Norwegian veterans from international peacekeeping operations. *Soc Psychiatry Psychiatr Epidemiol* 2003;38(11):605-10.
42. Shigemura J, Nomura S. Mental health issues of peacekeeping workers. *Psychiatry Clin Neurosci* 2002;56(5):483-91.
43. Ward W. Psychiatric morbidity in Australian veterans of the United Nations peacekeeping force in Somalia. *Aust N Z J Psychiatry* 1997;31(2):184-93.
44. Birenbaum R. Peacekeeping stress prompts new approaches to mental-health issues in Canadian military. *CMAJ* 1994;151(10):1484-9.
45. Newman E, Orsillo SM, Herman DS, Niles BL, Litz BT. Clinical presentation of disorders of extreme stress in combat veterans. *J Nerv Ment Dis* 1995;183:628-632.
46. Ford JD. Disorders of extreme stress following war-zone military trauma: associated features of posttraumatic stress disorder or comorbid but distinct syndromes? *J Consult Clin Psychol* 1999;67(1):3-12.
47. Hall DP, Jr. Peacekeeping duty and PTSD.[comment]. *Am J Psychiatry* 1997;154(10):1482-3.

48. Hall DP. Stress, suicide, and military service during Operation Uphold Democracy. *Mil Med* 1996;161:159-162.
49. Bartone PT, Adler AB, Vaitkus MA. Dimensions of psychological stress in peacekeeping operations. *Mil Med* 1998;163(9):587-93.
50. *Occupational Conversion Manual: Enlisted/Officer/Civilian*. Washington, DC: Department of Defense, Office of the Assistant Secretary of Defense, Force Management and Personnel; 1991.
51. *The International Classification of Diseases, 9th Revision, Clinical Modification. 3rd ed.* Washington, DC: US Department of Health and Human Services; 1991.
52. Gray GC, Hawksworth A, Smith TC, Kang HK, Knoke JD, Gackstetter GD. Gulf War veterans' health registries. Who is most likely to seek evaluation? *Am J Epidemiol* 1998;148:343-349.
53. Smith TC, Smith B, Ryan MA, Gray GC, Hooper TI, Heller JM, et al. Ten years and 100,000 participants later: occupational and other factors influencing participation in US Gulf War health registries. *J Occup Environ Med* 2002;44(8):758-68.
54. Smith TC, Jimenez DL, Smith B, Gray GC, Hooper TI, Gackstetter GD, et al. The postwar hospitalization experience of Gulf War veterans participating in US health registries. *J Occup Environ Med* 2004;46(4):386-397.
55. Brundage JF, Kohlhasse KF, Gambel JM. Hospitalization experiences of U.S. servicemembers before, during, and after participation in peacekeeping operations in Bosnia-Herzegovina. *Am J Ind Med* 2002;41(4):279-84.
56. Lange JL, Schwartz DA, Doebbeling BN, Heller JM, Thorne PS. Exposures to the Kuwait oil fires and their association with asthma and bronchitis among Gulf War veterans. *Environ Health Perspect* 2002;110(11):1141-1146.
57. SAS Institute Inc. SAS/STAT Software Version 9.0. Cary, NC: SAS Institute Inc.; 2002.
58. Knoke JD, Gray GC. Hospitalizations for unexplained illnesses among U.S. veterans of the Persian Gulf War. *Emerg Infect Dis* 1998;4(2):211-219.
59. Gray GC, Kaiser KS, Hawksworth AW, Hall FW, Barrett-Connor E. Increased postwar symptoms and psychological morbidity among U.S. Navy Gulf War veterans. *Am J Trop Med Hyg* 1999;60(5):758-66.

60. Haley R. Bias from the "healthy - warrior effect" and unequal follow-up in three governmental studies of health effects of the Gulf War. *Am J Epidemiol* 1998;147:in press.
61. Gray GC, Knoke JD, Berg SW, Wignall FS, Barrett-Connor E. Counterpoint: Responding to suppositions and misunderstandings. *Amer J Epidemiol* 1998;148:328-333.
62. Brundage JF, Kohlhase KF, Rubertone MV. Hospitalizations for all causes of U.S. military service members in relation to participation in Operations Joint Endeavor and Joint Guard, Bosnia-Herzegovina, January 1995 to December 1997.[comment]. *Mil Med* 2000;165(7):505-11.
63. Haley RW, Hom J, Roland PS, Bryan WW, Van Ness PC, Bonte FJ, et al. Evaluation of neurologic function in Gulf War veterans. A blinded case-control study.[see comment]. *JAMA* 1997;277(3):223-30.
64. Gray GC, Chesbrough KB, Ryan MAK, Amoroso PJ, Boyko EJ, Gackstetter GD, et al. The Millennium Cohort Study: a 21-year prospective cohort study of 140,000 military personnel. *Mil Med* 2002;167(6):483-488.

TABLE 1. Characteristics of Active Duty Veterans Deployed to the Gulf War, Southwest Asia Following the Gulf War, and Bosnia (August 1, 1990, To December 31, 2000).

Characteristic	1991 Gulf War Veterans n (%) (N=455,465)	Service members only deployed to Southwest Asia n (%) (N=249,047)	Service members only deployed to Bosnia n (%) (N=44,341)
Gender			
Male	426,393 (93.6)	230,287 (92.5)	39,287 (88.6)
Female	29,072 (6.4)	18,760 (7.5)	5,054 (11.4)
Age at time of deployment (years)			
17-22	158,362 (34.8)	95,694 (38.4)	14,097 (31.8)
23-27	134,588 (29.5)	66,984 (26.9)	15,202 (34.3)
28-33	86,782 (19.1)	43,042 (17.3)	7,914 (17.8)
34-65	75,733 (16.6)	43,327 (17.4)	7,128 (16.1)
Pre-war hospitalization			
No	421,293 (92.6)	238,486 (95.8)	42,279 (95.3)
Yes	33,554 (7.4)	10,561 (4.2)	2,062 (4.7)
Marital status			
Single	220,172 (48.3)	137,713 (55.3)	22,566 (50.9)
Married	235,923 (51.7)	111,334 (44.7)	21,775 (49.1)
Military pay grade			
Officer	46,393 (10.2)	26,061 (10.5)	4,925 (11.1)
Enlisted	409,072 (89.8)	222,986 (89.5)	39,416 (88.9)
Race/ethnicity			
Black	109,125 (24.0)	44,446 (17.4)	9,756 (22.0)
White	303,610 (66.6)	184,808 (74.2)	29,460 (66.4)
Hispanic	16,438 (3.6)	17,632 (7.1)	4,750 (10.7)
Other	26,292 (5.8)	3,161 (1.3)	375 (0.9)
Branch of service			
Air Force	43,618 (9.6)	66,332 (26.6)	7,551 (17.0)
Army	236,347 (51.9)	30,626 (12.3)	33,625 (75.8)
Navy and Coast Guard	99,345 (21.8)	130,191 (52.6)	2,815 (6.4)
Marines	76,105 (16.7)	21,170 (8.5)	350 (0.8)
Occupational category			
Electronic equipment repair	36,087 (7.9)	40,520 (16.3)	3,757 (8.5)
Infantry, gun crews	126,004 (27.7)	18,883 (7.6)	11,321 (25.5)
Communications/ intelligence	49,195 (10.8)	22,264 (8.9)	4,988 (11.2)
Health care	25,245 (5.5)	8,050 (3.2)	2,310 (5.2)
Other technical	10,303 (2.3)	9,033 (3.6)	1,127 (2.5)
Functional Support	52,371 (11.5)	41,624 (16.7)	6,304 (14.2)
Electrical/ mechanical repair	87,158 (19.1)	68,090 (27.3)	7,142 (16.1)
Craftsmen	16,405 (3.6)	14,437 (5.8)	1,218 (2.8)
Service & supply handlers	46,957 (10.3)	17,112 (6.9)	5,883 (13.3)
Non-occupational	5,740 (1.3)	9,084 (3.7)	291 (0.7)

TABLE 2. Adjusted Hazard Ratios and 95% Confidence Intervals for the Outcome of “Any Cause” Post-deployment Hospitalization Among Active Duty Veterans Deployed to the Gulf War, Southwest Asia Following the Gulf War, and Bosnia (August 1, 1990, to December 31, 2000).

Characteristic	Number of subjects	Number (%) Hospitalized	HR*	95% CI*
Theater				
Gulf War [†]	455,465	77,741 (17.1)	-	-
Southwest Asia following the Gulf War	249,047	27,531 (11.1)	1.05	(1.02, 1.08)
Bosnia	44,341	3,257 (7.4)	0.69	(0.66, 0.72)
Gender				
Male [†]	695,967	97,161 (14.0)	-	-
Female	52,886	11,368 (21.5)	1.54	(1.51, 1.57)
Age at time of deployment (years)				
17-22 [†]	268,153	32,784 (12.2)	-	-
23-27	216,774	28,033 (12.9)	0.98	(0.96, 1.00)
28-33	137,738	23,869 (17.3)	1.12	(1.10, 1.14)
34-65	126,188	23,843 (18.9)	1.32	(1.29, 1.35)
Pre-deployment hospitalization				
No [†]	702,688	97,792 (13.9)	-	-
Yes	46,165	10,737 (23.3)	1.67	(1.64, 1.70)
Marital status				
Single [†]	380,451	47,523 (12.5)	-	-
Married	368,402	61,006 (16.6)	1.04	(1.03, 1.06)
Military pay grade				
Officer [†]	77,379	12,064 (15.6)	-	-
Enlisted	671,474	96,465 (14.4)	1.23	(1.21, 1.26)
Race/ethnicity				
Black [†]	162,327	26,412 (16.3)	-	-
White	517,878	72,933 (14.1)	1.05	(1.03, 1.07)
Hispanic	38,820	4,653 (12.0)	0.91	(0.88, 0.94)
Other	29,828	4,531 (15.2)	1.00	(0.97, 1.03)
Branch of service				
Air Force [†]	117,501	15,737 (13.4)	-	-
Army	300,598	51,538 (17.2)	1.24	(1.21, 1.26)
Navy and Coast Guard	233,129	29,215 (12.5)	1.03	(1.01, 1.05)
Marines	97,625	12,039 (12.3)	0.99	(0.96, 1.01)
Occupational category				
Electronic equipment repair [†]	80,364	10,035 (12.5)	-	-
Infantry, gun crews	156,158	23,121 (14.8)	1.08	(1.05, 1.10)
Communications/ intelligence	76,447	10,927 (14.3)	1.00	(0.97, 1.03)
Health care	35,605	7,835 (22.0)	1.35	(1.31, 1.39)
Other technical	20,463	3,035 (14.8)	1.05	(1.01, 1.09)
Functional Support	100,299	15,141 (15.1)	1.01	(0.99, 1.04)

Electrical/ mechanical repair	162,390	21,492 (13.2)	1.03	(1.01, 1.06)
Craftsmen	32,060	4,411 (13.8)	1.09	(1.05, 1.13)
Service & supply handlers	69,952	10,403 (14.9)	1.05	(1.02, 1.08)
Non-occupational	15,115	2,129 (14.1)	1.20	(1.14, 1.26)

* HR = adjusted hazard ratio; CI = confidence interval.

† Reference category.

TABLE 3. Adjusted Hazard Ratios for Post-deployment Hospitalizations by Major Three-Digit ICD-9-CM* Categories Among Active Duty Veterans Deployed to Southwest Asia Following the Gulf War, and to Bosnia Compared with those Deployed to the Gulf War (August 1, 1990, to December 31, 2000).

ICD-9-CM Codes*	Major Diagnostic Categories	Gulf War [†] (N=455,465)	Southwest Asia (N=249,047)		Bosnia (N=44,341)	
		N (%) Hospitalized	N (%) Hospitalized	HR [‡] (95% CI)	N (%) Hospitalized	HR [‡] (95% CI)
001-139	Infection and parasitic	6,196 (1.4)	1,900 (0.8)	1.03 (0.93, 1.13)	272 (0.6)	0.68 (0.57, 0.81)
140-239	Neoplasms	4,576 (1.0)	1,583 (0.6)	1.03 (0.93, 1.15)	153 (0.4)	0.61 (0.50, 0.76)
240-279	Endocrine, nutritional, and metabolic diseases	4,705 (1.0)	1,882 (0.8)	1.02 (0.92, 1.13)	198 (0.5)	0.69 (0.57, 0.84)
280-289	Blood diseases	3,106 (0.7)	1,029 (0.4)	0.93 (0.80, 1.07)	229 (0.5)	0.93 (0.75, 1.15)
290-319	Mental disorders	11,509 (2.5)	4,726 (1.9)	1.34 (1.26, 1.43)	634 (1.4)	1.08 (0.96, 1.21)
320-389	Nervous system diseases	5,359 (1.2)	1,651 (0.7)	1.01 (0.91, 1.12)	167 (0.4)	0.66 (0.54, 0.81)
390-459	Circulatory system diseases	6,595 (1.5)	2,329 (0.9)	1.06 (0.97, 1.16)	231 (0.5)	0.70 (0.59, 0.83)
460-519	Respiratory system diseases	9,218 (2.0)	3,266 (1.3)	1.08 (1.00, 1.16)	315 (0.7)	0.73 (0.63, 0.84)
520-579	Digestive system diseases	16,670 (3.7)	5,856 (2.4)	0.99 (0.94, 1.05)	568 (1.3)	0.60 (0.54, 0.67)
580-629	Genitourinary system diseases	7,983 (1.8)	2,606 (1.1)	1.00 (0.92, 1.09)	294 (0.7)	0.60 (0.51, 0.70)
680-709	Skin diseases	4,294 (0.9)	1,458 (0.6)	0.99 (0.88, 1.11)	137 (0.3)	0.57 (0.46, 0.71)
710-739	Musculoskeletal system diseases	23,428 (5.1)	7,595 (3.1)	1.06 (1.01, 1.12)	891 (2.0)	0.78 (0.71, 0.86)
780-799	Symptoms, signs, and ill-defined conditions	9,281 (2.0)	3,184 (1.3)	1.03 (0.95, 1.11)	404 (0.9)	0.82 (0.71, 0.94)
800-999	Injury and poisoning	16,524 (3.6)	5,885 (2.4)	1.12 (1.06, 1.19)	869 (2.0)	0.80 (.072, 0.88)

*International Classification of Diseases, Ninth Edition, Clinical Modification.

[†]Reference group.

[‡]HR = adjusted hazard ratio; CI =confidence interval.

TABLE 4. Adjusted Hazard Ratios for Post-deployment Hospitalization for Specific Diagnoses of Interest Among Active Duty Veterans Deployed to the Gulf War, Southwest Asia following the Gulf War, and Bosnia (August 1, 1990, to December 31, 2000).

ICD-9 CM Code *	Specific Diagnosis	Gulf War [†] (N=455,465)	Southwest Asia (N=249,047)		Bosnia (N=44,341)			
		Count (%)	Count (%)	HR [‡]	95% CI	Count (%)	HR [‡]	95% CI
354-355	Mononeuritis	1,239 (0.27)	323 (0.13)	0.88	0.70, 1.10	30 (0.07)	0.55	0.35, 0.88
493	Asthma	952 (0.21)	314 (0.13)	1.22	0.96, 1.56	48 (0.11)	0.86	0.56, 1.31
140-208	Malignant neoplasms	939 (0.21)	364 (0.15)	0.94	0.74, 1.20	48 (0.11)	0.82	0.54, 1.24
250	Diabetes	535 (0.12)	206 (0.08)	0.95	0.69, 1.30	17 (0.04)	0.54	0.29, 1.00
580-586	Nephritis	262 (0.06)	108 (0.04)	1.30	0.84, 2.01	10 (0.02)	0.47	0.20, 1.08
729.1	Fibromyalgia	193 (0.04)	42 (0.02)	0.96	0.52, 1.77	5 (0.01)	0.71	0.22, 2.33
186	Testicular cancer	135 (0.03)	54 (0.02)	0.64	0.32, 1.28	8 (0.02)	0.80	0.27, 2.39
340	Muscular dystrophy	74 (0.02)	13 (0.01)	0.19	0.03, 1.42	6 (0.01)	0.49	0.05, 4.83
714	Rheumatoid arthritis	47 (0.01)	25 (0.01)	1.56	0.63, 3.84	2 (<0.01)	0.99	0.16, 6.19
710.0	Systemic lupus erythematosus	31 (0.01)	17 (0.01)	2.10	0.69, 6.38	1 (<0.01)	0.58	0.05, 6.50
335.20	Amyotrophic lateral sclerosis	6 (<0.01)	2 (<0.01)	-	-	0 (<0.01)	-	-

*International Classification of Diseases, Ninth Edition, Clinical Modification.

[†]Reference group.

[‡]HR = adjusted hazard ratio; CI =confidence interval.

Measure of association could not be calculated due to sparse outcome data.

REPORT DOCUMENTATION PAGE

The 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 the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 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 YY) 29 July 2004		2. Report Type New		3. DATES COVERED (from - to) 1991-Present	
4. TITLE AND SUBTITLE A Comparison of the Postdeployment Hospitalization Experience of US Military Personnel Following Service in the 1991 Gulf War, Southwest Asia After the Gulf War, and Bosnia				5a. Contract Number: 5b. Grant Number: 5c. Program Element: 5d. Project Number: 5e. Task Number: 5f. Work Unit Number: 60002 5g. IRB Protocol Number: 31283 (199-0005)	
6. AUTHORS Besa Smith, MPH; Tyler C. Smith, MS; Margaret A.K. Ryan, MD, MPH; and Gregory C. Gray, MD, MPH					
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Health Research Center P.O. Box 85122 San Diego, CA 92186-5122					
8. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES) Chief, Bureau of Medicine and Surgery Code M2 2300 E St NW Washington DC 20372-5300					
9. PERFORMING ORGANIZATION REPORT NUMBER Report 04-25					
10. Sponsor/Monitor's Acronyms(s)					
11. Sponsor/Monitor's Report Number(s)					
12 DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT (maximum 200 words) Much attention has been given to the impact of deployment upon the health of veterans from the first Gulf War. While differences in self-reported symptoms have been common, no specific exposures have been implicated. Some have suggested that stress from deployment is the chief cause for multi-symptom conditions among 1991 Gulf War veterans. We sought to examine the impact of large military deployments upon hospitalization experience. Hospitalization records from October 1, 1988, through December 31, 2000, were examined for all active-duty personnel deployed exclusively to the Gulf War, Southwest Asia, or Bosnia. Cox's hazard modeling was used to model time until first postdeployment hospitalization, separation from active duty, or December 31, 2000, whichever occurred first, while controlling for influential covariates and temporal changes. In comparison with Gulf War veterans ($n = 455,465$), personnel deployed to Southwest Asia after the Gulf War ($n = 249,047$) were at a slight increased risk of hospitalization (hazard ratio = 1.05; 95% confidence interval: 1.02, 1.08). However, personnel deployed to Bosnia ($n = 44,341$) were at decreased risk for any-cause hospitalization (HR = 0.69; 95% CI: 0.66, 0.72). While these findings do not fully explain the complexity of postdeployment health experiences, they do not support the theory of a unique illness in 1991 Gulf War veterans.					
15. SUBJECT TERMS hospitalization, morbidity, Persian Gulf syndrome, military medicine, military personnel, veterans, combat disorders					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UNCL	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON Commanding Officer
a. REPORT UNCL	b. ABSTRACT UNCL	c. THIS PAGE UNCL			19b. TELEPHONE NUMBER (INCLUDING AREA CODE) COMM/DSN: (619) 553-8429