After More than 10 Years of Gulf War Veteran Medical Evaluations, What Have We Learned?

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Abstract: Since the 1991 Gulf War, more than 10 years and $1 billion dollars of health evaluations and research have been invested in understanding illnesses among Gulf War veterans. We examined the extensive published healthcare utilization data in an effort to summarize what has been learned. Using multiple search techniques, data as of June 2003 from four different national Gulf War health registries and numerous hospitalization and ambulatory care reports were reviewed. Thus far, published reports have not revealed a unique Gulf War syndrome nor identified specific exposures that might explain postwar morbidity. Instead, they have demonstrated that Gulf War veterans have had an increase in multi-symptom condition, injury, and mental health diagnoses. While these diagnoses are similar to those experienced by other comparable military populations, their explanation is not fully understood. New strategies to identify risk factors for, and to reduce, such postdeployment conditions are summarized.

Introduction

Soon after returning from the Gulf War conflict, veterans from the United States, United Kingdom, and Canada became concerned that their symptoms and illnesses were due to military service. After two U.S. epidemic investigations were unable to construct a case definition of a war-related syndrome or to implicate specific wartime exposures, special healthcare registries were established to systematically evaluate the health of Gulf War veterans (Table 1). As of June 2003, more than 130,000 U.S., U.K., and Canadian Gulf War veterans had been systematically evaluated under these clinical programs. In conjunction with the health registry evaluations, the United States, United Kingdom, and Canada commissioned numerous medical research projects to examine whether postwar morbidity was associated with Gulf War service. Additional investigative efforts have been made to understand these illnesses through numerous external panel reviews and a large risk management organization. It has been estimated that more than $1 billion has been invested in understanding and treating Gulf War veterans’ illnesses (R. Riddle, Executive Secretary of the Armed Forces Epidemiological Board, Falls Church VA, personal communication, 2002).

This article reviews what has been learned from these efforts. As other authors have recently reviewed various studies of Gulf War veterans’ health including mortality studies, symptom studies, infectious diseases reports, and healthcare policy changes, and others are reviewing reproductive outcomes, this review was narrowed to studies involving healthcare utilization.

Methods

We used MEDLINE, expert panel reports, Current Contents, reports to Congress, and a topical Gulf War veteran bibliography with 5520 references to identify published research and ongoing research (as of November 2003) relevant to our objectives.

Results

Gulf War Veteran Healthcare Registry Studies

Health registries established. The methodology of the Gulf War veteran healthcare registries by the U.S. Department of Veterans Affairs (VA), the U.S. Department of Defense (DoD), and the United Kingdom, has been previously summarized. The Canadian registry was similar. In brief, registry evaluation was heavily advertised and made readily available to all Gulf War veterans and in some instances family members. After verification, the Gulf War veteran was offered medical evaluation. Participants seeking such evaluation normally received an initial screening exam-
Most Gulf War veteran registry evaluations have been conducted at VA medical treatment facilities. A 1999 review of data from 52,835 VA registry participants listed a wide variety of symptoms and diagnoses without an apparent internal variation by military characteristics, such as branch of service (Army, Navy, Air Force, Marines) and service component (active, Reserve, National Guard). The frequency of major self-reported symptoms (fatigue, skin rash, headache, muscle and joint pain, and memory loss) showed an increasing trend over a 3-year evaluation period (August 1992 to July 1995), but the proportion of veterans who received a physician’s diagnosis of any medical condition remained fairly constant at about 72% to 76% during the same period. No single category of disease increased or decreased substantially over time. A significant proportion of veterans had no health complaints at the time of their registry examination and just wanted to participate.

Within the broad diagnostic categories, the most frequently diagnosed medical conditions were diseases of musculoskeletal and connective tissue, followed by mental diseases, diseases of the respiratory system, skin and subcutaneous tissue diseases, and digestive diseases.

Reviewing existing data and reports, the most frequently reported symptoms and diagnoses from the U.S., U.K., and Canadian registries were remarkably similar. Fatigue, rashes, headache, muscle and joint pain, and cognitive problems were all quite common (Table 2), as were related, often nonspecific, diagnoses (Table 3). These findings have been important in consistently demonstrating the broad spectrum of symptoms and illnesses Gulf War veterans have experienced and their similarity to the clinical findings from other nonmilitary adult outpatient populations.

Predictors of registry participation. In 1998 and again in 2002, DoD and VA investigators published risk factor analysis of participation in either the DoD or VA healthcare registries. The 1998 report documented that ~28% of registry participants were not given a specific diagnosis. We also identified a possible association between registry participation and news stories.

Table 1. Special Gulf War veteran health evaluations

<table>
<thead>
<tr>
<th>Sponsor</th>
<th>Registry name</th>
<th>Start date</th>
<th>Number of veterans evaluated</th>
<th>Number deployed</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Department of Veterans Affairs</td>
<td>Persian Gulf Veterans Health Registry</td>
<td>August 1992</td>
<td>86,463&lt;sup&gt;a&lt;/sup&gt;</td>
<td>697,000</td>
</tr>
<tr>
<td>U.S. Department of Defense</td>
<td>Comprehensive Clinical Evaluation Program</td>
<td>June 1994</td>
<td>58,596&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>U.K. Ministry of Defence</td>
<td>Gulf War Medical Assessment Programme</td>
<td>July 1993</td>
<td>3,000&lt;sup&gt;c&lt;/sup&gt;</td>
<td>53,000</td>
</tr>
<tr>
<td>Canada Department of National Defence</td>
<td>Canadian Gulf War Registry</td>
<td>January 1995</td>
<td>213&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4,500</td>
</tr>
</tbody>
</table>

<sup>a</sup>Participants as of September 27, 2003.
<sup>b</sup>Participants as of June 1, 2002 when the program was transitioned to a postdeployment health clinical practice guideline program.
<sup>c</sup>Estimated participation, registry closed.
<sup>d</sup>Participants as of 1998 when the registry was closed.
involving Gulf War veterans. In 2002, considering the 103,261 Gulf War veteran health registry evaluations (as of September 1999), Gulf War veterans most likely to participate included Army personnel, Reserve and National Guard personnel, personnel aged 31 years, female personnel, personnel thought to be in the vicinity of oil-well fire smoke, personnel likely exposed to the plumes from munition destruction at Khamisiyah, Iraq, in March 1991, and personnel in-theater during the armed combat.

Table 2. Prevalence of frequently reported symptoms, by Gulf War veteran registry

<table>
<thead>
<tr>
<th>Symptom</th>
<th>U.S. Department of Veterans Affairs (n=52,835)</th>
<th>U.S. Department of Defense (n=53,032)a</th>
<th>United Kingdom (n=1000)</th>
<th>Canada (n=104)b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue</td>
<td>20.5</td>
<td>37.2</td>
<td>42.1</td>
<td>86.5</td>
</tr>
<tr>
<td>Skin rash</td>
<td>18.4</td>
<td>24.0</td>
<td>19.4</td>
<td>47.1</td>
</tr>
<tr>
<td>Headache</td>
<td>18.0</td>
<td>32.7</td>
<td>25.6</td>
<td>65.4</td>
</tr>
<tr>
<td>Muscle and joint pain</td>
<td>16.8</td>
<td>40.9c</td>
<td>39.5</td>
<td>75.0</td>
</tr>
<tr>
<td>Cognitive problems</td>
<td>14.0</td>
<td>33.5d</td>
<td>26.1</td>
<td>84.6</td>
</tr>
<tr>
<td>Shortness of breath</td>
<td>7.9</td>
<td>19.0</td>
<td>24.3</td>
<td>33.0</td>
</tr>
<tr>
<td>Sleep disturbance</td>
<td>5.9</td>
<td>29.1e</td>
<td>21.2</td>
<td>74.0</td>
</tr>
<tr>
<td>Diarrhea and other gastrointestinal</td>
<td>4.6</td>
<td>27.0f</td>
<td>21.8</td>
<td>55.8</td>
</tr>
<tr>
<td>No complaint</td>
<td>12.3</td>
<td>41.1g</td>
<td>7.4</td>
<td>0</td>
</tr>
</tbody>
</table>

*aParticipants as of May 31, 2000.

From 104 veterans evaluated at Ottawa’s Gulf War Clinic April 1995 to December 1997.

*aAnswered “yes” to “muscle pain,” “joint pain,” or both.

*dAnswered “yes” to “difficulty concentrating,” “memory loss,” or both.

*cAnswered “yes” to any of the following: “sleep disturbance,” “loud snoring,” or “stopped breathing while sleeping.”

*eAnswered “yes” to “abdominal pain,” “diarrhea,” or both.

*Did not answer “yes” to 18 questions about symptoms, including “Do you have any other symptoms?”

Table 3. Percent distribution of selected diagnoses for Gulf War veterans participating in a health registry

<table>
<thead>
<tr>
<th>Diagnoses</th>
<th>ICD-9 code</th>
<th>% of diagnoses</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>—</td>
<td>27.0</td>
</tr>
<tr>
<td>Malaise and fatigue</td>
<td>780.7</td>
<td>22.0</td>
</tr>
<tr>
<td>Headache</td>
<td>781.0</td>
<td>21.0</td>
</tr>
<tr>
<td>Pain in joint</td>
<td>719.4</td>
<td>13.2</td>
</tr>
<tr>
<td>Sleep disturbances</td>
<td>780.5</td>
<td>7.9</td>
</tr>
<tr>
<td>Depressive disorder, not elsewhere classified</td>
<td>311</td>
<td>4.1</td>
</tr>
<tr>
<td>Lumbago</td>
<td>724.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Psychalgia</td>
<td>307.8</td>
<td>3.9</td>
</tr>
<tr>
<td>Other specified adjustment reactions</td>
<td>309.8</td>
<td>3.9</td>
</tr>
<tr>
<td>Essential hypertension, unspecified</td>
<td>401.9</td>
<td>3.6</td>
</tr>
<tr>
<td>Contact dermatitis and other eczema, unspecified</td>
<td>692.9</td>
<td>3.6</td>
</tr>
<tr>
<td>Unspecified sinusitis (chronic)</td>
<td>473.9</td>
<td>3.2</td>
</tr>
<tr>
<td>Other and unspecified noninfectious gastroenteritis and colitis</td>
<td>558.9</td>
<td>2.8</td>
</tr>
<tr>
<td>Asthma, unspecified</td>
<td>493.9</td>
<td>2.7</td>
</tr>
<tr>
<td>Migraine, unspecified</td>
<td>346.9</td>
<td>2.6</td>
</tr>
<tr>
<td>Allergic rhinitis, cause unspecified</td>
<td>477.9</td>
<td>2.5</td>
</tr>
<tr>
<td>Anxiety states</td>
<td>300.0</td>
<td>2.4</td>
</tr>
<tr>
<td>Osteoarthritis, unspecified</td>
<td>715.9</td>
<td>2.2</td>
</tr>
<tr>
<td>Alopecia</td>
<td>704.0</td>
<td>2.1</td>
</tr>
<tr>
<td>Irritable colon</td>
<td>564.1</td>
<td>1.9</td>
</tr>
</tbody>
</table>

*Percentages reflect data from 69,941 Gulf War veterans who completed the VA registry examination as of September 30, 1999. A special non-ICD-9 code, “DX111,” was used as well as ICD-9 code V65.5 (person with feared complaint in whom no diagnoses were made) to indicate veterans with no diagnoses. Both are considered as missing.

*Percentages are derived from 53,032 DoD registry participants as of May 31, 2000. Diagnoses were reported in the any of the primary or six secondary diagnostic fields. A code of “xxx.xx” was interpreted as missing.

*Four-digit code from International Classification of Diseases, 9th Revision, Clinical Modification, 3rd ed.
Other registry studies. Gulf War veteran registries have also been used to examine self-reported symptom and exposure data for possible illness associations and to evaluate the etiologic nature of increased symptom reporting. In a June 1998 report, Kroenke et al. examined records from 18,495 DoD evaluations and concluded that the latency of symptom reporting (often >1 year after the war) and the poor correlation with self-reported war exposures did not support the hypothesis that a specific exposure(s) resulted in post-war symptoms. In a 1998 case series, Escalante and Fischback tabulated the rheumatic manifestations of 145 VA registry participants who were referred for rheumatologic evaluation. The authors noted that the types of conditions Gulf War veterans experienced after the war were not unusual (e.g., fibromyalgia, nonspecific arthralgias, osteoarthritis) and they inferred no suggestion of a new Gulf War-related syndrome. Two other teams of researchers studied a total of 457 Gulf War veterans evaluated for possible rheumatologic conditions and noted a high prevalence of common conditions, also suggesting no unique Gulf War diagnosis or condition. Among the first 65 DoD registry patients seen for neurologic symptoms at one medical treatment facility during 1994, Newmark and Clayton found no consistent patterns of neurologic disease. In 1998, Roy et al. studied registry data from 12,744 DoD registry participants who had principal or secondary diagnoses coded in the “signs, symptoms, and ill-defined conditions” diagnostic category of the International Classification of Diseases, 9th revision (ICD-9). They noted that many of the diagnoses in this category represented common symptoms and concluded that there was no evidence of a new syndrome. In a 1999 report, Kipen et al. surveyed 1935 VA registry participants and found that 16% of registry participants reported vague symptoms consistent with chronic fatigue syndrome, further suggesting no evidence of a new disease entity.

In contrast to the abovementioned reports of no unusual morbidity, Das et al. summarized their pulmonary evaluations of 48 VA Gulf War veterans, documenting a higher-than-expected midvital flow capacity, suggesting chronic inflammation of upper airways. They speculated that these findings may be chronic manifestations of exposure to smoke and/or other irritants from the Kuwaiti oil well fires during the war. Additionally, after seeing 16 Gulf War veteran females in his gynecology clinic for the DoD registry, Wittich concluded that a high proportion had gynecologic problems during and after service in the Gulf.

Broad Hospitalizations Studies

In-theater hospitalizations. Data are sparse regarding in-theater Gulf War hospitalizations. Electronic records were not routinely kept and some inpatient medical records have only been recently located. Wintermeyer and colleagues reviewed 574 admissions among U.S. servicemen and Iraqi prisoners at an Army support hospital during the war. They concluded that hospitalization rates fluctuated with combat and that care to both U.S. soldiers and Iraqi prisoners was of similar quality.

Postwar hospitalization studies of electronic data. A number of controlled epidemiologic studies of DoD hospitalizations have aided veterans and public health policymakers in examining evidence for increased postwar morbidity among Gulf War veterans. The first such study, published in 1996, compared Gulf War veterans and nondeployed veterans for postwar hospitalizations during 25 months after the war. Gulf War veterans who remained on active duty were found to have increased postwar odds of hospitalizations in 5 of 45 multivariate statistical models. However, these differences were not consistent over the 25 months of study and were likely due to deferred medical care or other previously recognized postwar conditions.

Because the hospitalization studies previously mentioned captured only data from personnel who were eligible for DoD hospital care, a comparison of Gulf War veteran and nondeployed veteran hospitalizations was published in 1998 using DoD, VA, and California nonfederal hospitalization data. These analyses captured data from Reserve and National Guard personnel, as well as former military personnel who no longer were eligible for federal health care. There was no evidence that Gulf War veterans were suffering increased hospitalizations for infectious diseases, cancers, endocrine diseases, nervous system diseases, blood diseases, circulatory system diseases, musculoskeletal diseases, or skin conditions. However, Gulf War veterans had proportionally more hospitalizations for fractures and bone and soft tissue conditions in DoD and California hospitals, and for respiratory diseases, digestive diseases, and vague symptom diagnoses in VA hospitals.

Increased risk of postwar injuries among Gulf War veterans has interested other investigators. Bell et al. compared hospitalizations before and after the war for both deployed and nondeployed veterans. They found that deployed veterans had evidence for increase risk taking behavior both before and after the war.

Recently, Blood and Aboumad compared the post-war hospitalization experience of U.S. Marines deployed to the Gulf War with similar Marines deployed to the Vietnam conflict. They found similar hospitalization rates for both cohorts and no unexplained differences in the proportional distribution of diagnostic categories.

Focused Hospitalization Studies

Specific diagnoses. DoD hospitalizations have also been studied for evidence that Gulf War veterans may be more prone than their nondeployed peers to suffer certain postwar diagnoses. Knoke et al. examined the
postwar diagnoses of the most common cancer among young males, testicular cancer, and found no evidence of increased risk among Gulf War veterans. In another study, these investigators searched for evidence of a new condition by using an aggregate of 77 ICD-9 diagnoses previously identified by the Centers for Disease Control and Prevention in monitoring for unexplained deaths. During the 50-month postwar period they found an increased hospitalization risk among Gulf War veterans beginning late in 1994. However, upon closer scrutiny, this increase was due to administrative hospitalizations and not due to a new illness.

Similarly, DoD hospitalization data were examined for evidence of unusual mental health morbidity that might be associated with the war. Dlugosz et al. examined 30,539 initial mental health hospitalizations from June 1991 through September 1993, and found that Gulf War veterans were more likely to be admitted for alcohol-related disorders, drug-related disorders, and acute reactions to stress than their nondeployed peers. The strongest predictor of postwar mental health hospitalization was prewar mental health hospitalization. With the exception of alcohol-related disorders, the authors found no association between service in combat units during the Gulf War and risk of postwar mental health hospitalization. Rothberg et al. similarly found moderate but transient increases of postwar ambulatory mental health or social problems among Gulf War veterans at one medical treatment facility in the southeastern United States.

Smith et al. compared Gulf War veterans with nondeployed veterans for the onset of three postwar conditions: systemic lupus erythematosus, amyotrophic lateral sclerosis (ALS), and fibromyalgia. Examining DoD hospital data from October 1988 through July 1997, they found no evidence that Gulf War veterans were more likely than their peers to be hospitalized for any of the three conditions. Most recently, using DoD, VA, and civilian hospitalization and ambulatory care data, federal investigators performed aggressive searches and comprehensive evaluations of veterans for evidence of Gulf War exposures and hospital outcomes, the exposed Gulf War veterans were not found to be at increased risk of hospitalization among deployed shipboard personnel. The

**Studies of Outpatient Encounters**

**In-theater outpatient visits.** A number of self-administered questionnaire surveys of U.S. military personnel serving in the Gulf War theater were conducted before the fighting began. Richards et al. surveyed 2598 U.S. military combat personnel serving in Saudi Arabia during September through December 1990, and found that respiratory disease symptoms were a frequent complaint. Among respondents, 43.1% complained of cough, 34.4% reported a sore throat, and 15.4% complained of chronic rhinorrhea. Hyams et al. surveyed 2022 soldiers stationed in various regions of Saudi Arabia during late 1990. They found that with an average stay of only 2 months, 57% had at least one incident of diarrhea and 20% reported that diarrhea kept them from conducting their duties. Respiratory disease and diarrheal disease were similar common problems among deployed shipboard personnel. The
impact of infectious diseases on Gulf War veterans is well described in two thorough reviews. A limited number of outpatient healthcare utilization reports are available from the Gulf War deployment period. Most are based on unofficial records and none include nondeployed controls. Hines evaluated 15,401 outpatient clinic visits that occurred among 16,400 heavy-armor division troops during the period November 1990 to February 1991. He found that men were more likely to be seen for orthopedic or dermatologic conditions, and women were more likely to be evaluated for psychiatric and optometric problems. Considering all visits of both male and female soldiers, ambulatory visits were most common for orthopedic problems (30.3%), respiratory problems (24.9%), and dermatologic problems (13.9%). In a review of 6772 visits in a U.S. Army armored cavalry unit, Wasserman et al. similarly found a high proportion of orthopedic, gastrointestinal, and respiratory problems among ambulatory visits during the Gulf War. Shaw et al. found that among 1820 medical encounters at two deployed Navy Fleet hospitals, the most frequent were injury category diagnoses (24%) and respiratory disease diagnoses (19%).

In an evaluation of female in-theater outpatient data, Hines evaluated 10,165 ambulatory visits, and concluded that while women occasionally have needs that merit the care of a gynecologist, more broadly trained clinicians were usually well equipped to provide female-soldier care. In a 1997 review article, Murphy et al. came to similar conclusions, but recommended better studies of gender-specific morbidity.

Perhaps the most comprehensive in-theater ambulatory care evaluation was performed by Hyams et al. in their surveillance of 40,000 Marines stationed in northeastern Saudi Arabia. They found that gastroenteritis and acute respiratory tract infections were most common. A gastroenteritis outbreak was abated after local fruits and vegetables were banned. A key element of success in determining the cause of diarrheal disease in the Gulf War theater was the availability of advance laboratory support. They also noted that respiratory disease outbreaks occurred soon after large groups of deployed personnel arrived in-theater.

Because electronic data for Gulf War veteran outpatient visits after the war were not available, postwar ambulatory care visits studies have been sparse. The VA has electronic outpatient data (Outpatient Care File) available back to 1980, but the data lacked key epidemiologic elements until improvements were made in 1996. Similarly, outpatient electronic data (Standard Ambulatory Data Record) first became available for DoD healthcare facilities in 1996. Neither of these systems has been evaluated for use among Gulf War veterans and their peers. However, they are available for the future study of other U.S. military cohorts.

Other Healthcare Utilization Studies

Healthcare utilization as captured by cross-sectional survey. Another approach to evaluate healthcare utilization among Gulf War veterans has been to perform surveys. Results have been mixed. Kang et al. reported that among the 11,441 Gulf War veterans and 9476 nondeployed veterans they surveyed in 1996 and 1997, the proportion reporting a hospitalization due to illness during the last year was higher among Gulf War veterans (RR = 1.22; 95% CI = 1.10–1.34). In another large postal survey conducted during 1997 through 1999, 12,049 Seabees who served during the Gulf War period were asked to complete questionnaires regarding their hospitalizations since 1990. Thirty-eight percent of Gulf War veterans and 35% of nondeployed veterans reported one or more hospitalizations. However, Cherry et al. in their survey of more than 14,378 U.K. veterans found similar self-reported hospitalizations 7 years after the war among Gulf War veterans compared to nondeployed veterans (52.5% vs. 49.0%, respectively).

In 1995, Stretch et al. reported a postal survey of 4334 Gulf War veterans and their nondeployed peers, finding that both active-duty and Reserve Gulf War veterans reported a higher prevalence than their nondeployed peers of visiting a physician within 2 weeks of completing the survey. Similarly, Steele in a survey of 2030 veterans found higher percentages of Gulf War veterans compared to nondeployed veterans to report being diagnosed or treated by a physician for 10 of 21 types of medical conditions. In contrast, in a 1998 report 3113 Canadian Gulf War veterans and 3439 nondeployed veterans were surveyed for contacts with healthcare professionals, hospital emergency room visits, and hospital admissions during the previous 12 months. The investigators found no evidence for increased healthcare visits, but Gulf War veterans did report more nonprescription drug use and more medical conditions. Health and types of diagnoses were the same across all military units, including a unit that had rotated home before the war even began. In the cross-sectional studies of more than 11,868 Navy Seabees, Gulf War veterans reported equal hospitalization rates compared to their nondeployed peers. However, Kang et al. in surveying more than 20,000 U.S. Gulf War era service personnel, found that Gulf War veterans reported more outpatient and inpatient visits than did their peers and they had more functional impairment, symptoms, and self-reported medical conditions.

Cancer registry data. In the only Gulf War veteran cancer registry study to date, Australian investigators recently evaluated cancer incidence among Gulf War veterans and nondeployed era veterans. Personal identifiers from 1833 Gulf War veterans and 2847
nondeployed veterans were linked to Australian national cancer registry data from January 1, 1991 through December 31, 1998. There was no statistically important difference in cancer incidence (total of 19 incident cases) between the Gulf War veteran and nondeployed veteran groups.

Discussion

Because of self-selection bias, recall bias, sensational media reports, and other potential confounders of self-reported information, registry data are limited in their epidemiologic value. Self-reported survey data have similar limitations. McCauley et al.78 found poor validity and reliability in self-reported Gulf War exposures. Similarly, electronic hospitalization data were designed for administrative purposes and their use in epidemiologic studies is not without problems.79 However, registry, self-reported, and electronic hospitalization data have been very useful in documenting both the wide spectrum of symptoms and their most commonly recorded diagnoses. Additionally, the healthcare registry programs have improved Gulf War veteran access to medical care. Thus, while the reports summarized have considerable limitations, the work has benefited Gulf War veterans, and considered together, these data lead to a number of conclusions.

Gulf War veterans, at least for several years after the war, were at increased risk of injuries as compared to their nondeployed peers. This has been made evident through mortality studies, hospitalization studies, and self-reported illness studies.72,83 These findings are consistent with previous studies of other war veterans.84 Some of the increase in injury risk may have been present prior to deployment35; other plausible explanations include increased stress, increased alcohol use, PTSD, and neurologic dysfunction.83,84 Whatever the cause, increased injury risk should be anticipated when considering the postdeployment health of military personnel returning from armed conflict.

Both hospitalization and self-reported symptom data demonstrate that Gulf War veterans are at increased risk of utilizing mental health resources and receiving mental health diagnoses. Among the nearly 100,000 U.S. health registry participants, mental disorders comprised approximately 15% to 36% of the VA and 48% of DoD health registry diagnoses. Studies suggest that Gulf War veterans are at increased risk of receiving a diagnosis of PTSD, depression, chronic fatigue, reduced cognitive functioning, multiple chemical sensitivity, and mood disorders. In a small, intensive, controlled evaluation of three veterans groups, one team of investigators discounted many of these reports, casting doubt on a true increase in the incidence of PTSD and other psychiatric diagnoses among Gulf War veterans, and suggesting that psychiatric diagnoses disorders alone cannot explain illnesses among Gulf War veterans. One investigator has used special brain imaging studies of a small number of Gulf War veterans to argue that symptomatic Gulf War veterans may have organic damage to the basal ganglia that may explain their illness.93,94 Whatever the causes, the general consensus among clinicians and epidemiologists is that Gulf War veterans are at increased risk of mental health disorder diagnoses and because of this risk, they merit special screening.31

The new suggestions that some Gulf War veterans who were possibly exposed to a subclinical chemical warfare nerve agent at Khamisiyah are more likely to suffer dysrhythmias and the new study suggesting certain Gulf War veterans may be at increased risk of ALS are intriguing. These observations merit continued scientific evaluation before they are fully embraced. Heal care utilization data have also been valuable in revealing personnel most likely to seek medical attention. Health registry participants were more likely Army personnel, Reserve and National Guard personnel, personnel aged ≥31 years, female personnel, personnel thought to be in the vicinity of oil-well fire smoke, personnel likely exposed to the Khamisiyah plume, and personnel in theater during the armed combat.26 With respect to postwar hospitalizations, important risk factors were female gender, prewar hospitalization, healthcare occupation, enlisted rank, service in the Army, and low rank.35,40,53 These data are useful in identifying populations to target for postdeployment interventions and in underscoring the importance of considering numerous covariates when conducting future postdeployment research.

Healthcare utilization data have also proven valuable for what they have not revealed. Health registry, and healthcare related epidemiologic studies, and the numerous statistical analyses of self-reported symptom data105 have failed to identify a unique constellation of symptoms or clinical signs that could be termed a “Gulf War syndrome.” The constellation of symptoms that Gulf War veterans report overlap with those of various multi-sympptom conditions106,107 as well as with conditions that veterans from previous conflicts have experienced.102,108 In addition, most research teams now agree that due to limitations of available Gulf War veteran data,109,110 it is unlikely that such a condition could be identified.

At present, much of Gulf War veteran concern has shifted from identifying a unique syndrome or a unique cause for illness to identifying effective therapies for Gulf War–related illnesses.111-117 Most researchers recognize that the conditions most strongly associated with Gulf War service are those involving self-reported symptoms.15 Hence, the focus on present and future medical research among Gulf War veterans and other military populations has shifted to evaluating treatments115,118 proven effective among other populations suffering from multisymptom-based conditions and evaluating how the health of Gulf War veterans changes over
Conclusions and Future Research Needs

Gulf War veterans have suffered a wide range of health problems since returning from the war. However, health-care registry data and epidemiologic studies of healthcare utilization have revealed no unique Gulf War syndrome nor identified specific exposures that might explain post-war morbidity. Instead, they have demonstrated that Gulf War veterans have had an increase in injury, mental health, and multisymptom condition diagnoses. These diagnoses are similar to those that have affected other military populations. Multisymptom conditions are now the focus of significant research.

Since the Gulf War, the DoD has improved disease and injury surveillance, and freely reported occurrences that may be associated with military service. This is evidenced by the recent U.S. DoD reports of the smallpox vaccine’s association with myopericarditis, and the reporting of case series of unexplained eosinophilic pneumonia and leishmaniasis among personnel deployed in Southwest Asia. Such close surveillance with rapid public reporting is commendable.

In addition to evaluating possible therapies for multisymptom conditions, federal research should now focus on identifying risk factors for the development of postdeployment symptom-based conditions. If military personnel who may be prone to developing multisymptom conditions are identified early in their service, special training and interventions might be employed to reduce this morbidity. In fact, the DoD seems to be moving in that direction in studying military personnel who have served in the recent conflicts in Afghanistan and Iraq. Predeployment, in-theater, and postdeployment data are being evaluated to identify predictors of postdeployment symptom-based illness. Personnel at high risk of developing multisymptom conditions may benefit from cognitive behavior therapy, coping skill training, or other interventions to help them prepare for the prolonged intensive stressors of warfare.

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Note: During preparation of an early draft of this manuscript, Dr. Gray was director of the Center for Deployment Health Research, the Naval Health Research Center, San Diego CA.

References

3. Lowther W. Mystery illness and the Gulf War. MacLean’s 1993;106:32–33.


