

Free Executive Summary

Gulf War and Health: Volume 6. Physiologic, Psychologic, and Psychosocial Effects of Deployment-Related Stress

Committee on Gulf War and Health: Physiologic, Psychologic, and Psychosocial Effects of Deployment-Related Stress

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SUMMARY

On August 2, 1990, Iraq invaded Kuwait, and Operation Desert Storm was launched on January 16, 1991, with an air offensive to liberate Kuwait. On February 24, 1991, the ground war began; by February 28, the war was over, and a ceasefire was signed in April. All U.S. troops who had participated in the ground war had returned home by June 13. About 697,000 U.S. military personnel were deployed to the Persian Gulf during the buildup and the war. Most of them were active-duty military personnel, but 261,871 reservists were called to active duty, and 106,047 of them were deployed to the gulf.

The United States is once again engaged in a military conflict in the Middle East. Operation Enduring Freedom (OEF) began on October 7, 2001, in response to the September 11, 2001, terrorist attacks on the United States. Troops are stationed in and around Afghanistan, Southwest Asia, and other locations for military and humanitarian purposes. Operation Iraqi Freedom (OIF) began on March 19, 2003, when U.S.-led coalition forces invaded Iraq. As of November 4, 2006, about 1.4 million U.S. troops had been deployed to the conflicts in OEF and OIF.

In response to the growing concern about the physical and psychologic health of the Gulf War veterans from the 1990-1991 conflict, Congress passed two laws in 1998: PL 105-277, the Persian Gulf War Veterans Act, and PL 105-368, the Veterans Programs Enhancement Act. Those laws directed the secretary of veterans affairs to enter into a contract with the National Academy of Sciences (NAS) to review and evaluate the scientific and medical literature regarding associations between illness and exposure to toxic agents, environmental or wartime hazards, and preventive medicines or vaccines in members of the armed forces who were exposed to such agents. PL 105-277 also gave NAS permission to identify “other agents, hazards, or medicines or vaccines to which members of the Armed Forces may have been exposed.” In 1996, the Presidential Advisory Committee on Gulf War Veterans’ Illnesses found that stress was an important contributor to those veterans’ illnesses and encouraged the government to continue its research on stress-related disorders. In response to the above laws, the Institute of Medicine (IOM) has had a program to examine health risks posed by specific agents and hazards to which Gulf War veterans might have been exposed during their deployment. Four reports have examined health effects related to depleted uranium, pyridostigmine bromide, sarin, and vaccines; insecticides and solvents; fuels, combustion products, and propellants; and infectious diseases. A fifth report by IOM evaluated the current health status of Gulf War-deployed veterans compared with their nondeployed counterparts.

In recent years, the charge to IOM has been expanded to include not only veterans of the 1990-1991 Gulf War but veterans returning from OEF and OIF. Many of the biologic and

chemical exposures and their possible health effects have been considered in previous IOM reports, but the health effects associated with deployment-related stress had yet to be considered.

A recent IOM report, *Gulf War and Health, Volume 4: Health Effects of Serving in the Gulf War*, reviewed the health status of Gulf War-deployed veterans. That report found that veterans of the Gulf War report higher rates of nearly all symptoms than their nondeployed counterparts; a higher prevalence not only of individual symptoms but of chronic multisymptom illnesses was also found among Gulf War-deployed veterans. Multisymptom-based medical conditions reported to occur more frequently among deployed Gulf War veterans include fibromyalgia, chronic fatigue syndrome, and multiple chemical sensitivity. The literature also demonstrates that deployment places veterans at increased risk for symptoms that meet diagnostic criteria for a number of psychiatric illnesses, particularly posttraumatic stress disorder (PTSD), anxiety disorders, depressive disorders, and substance abuse. In light of the 1991 Gulf War and the nature of OEF and OIF, the Department of Veterans Affairs (VA) requested that IOM comprehensively review, evaluate, and summarize the peer-reviewed scientific and medical literature regarding the association between deployment-related stress and long-term adverse health effects in Gulf War veterans. In response to VA's request, IOM appointed the Committee on Gulf War and Health: Physiologic, Psychologic, and Psychosocial Effects of Deployment-Related Stress to conduct the review.

COMMITTEE'S INTERPRETATION OF ITS CHARGE

Given the committee's charge from VA—to assess the long-term health effects of deployment-related stress—the committee began by defining the deployment in question as “deployment to a war zone.” Combat is one of the most potent stressors that a person can experience, but as military conflicts have evolved to include more guerilla warfare and insurgent activities, restricting the definition of deployment-related stressors to combat may fail to acknowledge other potent stressors experienced by military personnel in a war zone or in the aftermath of combat. Those stressors include constant vigilance against unexpected attack, the absence of a defined front line, the difficulty of distinguishing enemy combatants from civilians, the ubiquity of improvised explosive devices, caring for the badly injured or dying, duty on the graves registration service, and being responsible for the treatment of prisoners of war. Deployment stressors associated with armed conflict include not only combat stressors but noncombat stressors. Non-combat-related stressors that might be experienced by deployed personnel are separation from family, friends, and colleagues; loss of or reduction in income; and concern over employment status when deployment ends. Therefore, the committee considered that military personnel deployed to a war zone, even if direct combat was not experienced, have the potential for exposure to deployment-related stressors and that the emotional and physical reactions of military personnel to those stressors can vary widely.

COMMITTEE'S APPROACH TO ITS CHARGE

The committee's charge was the comprehensive review, evaluation, and summary of the peer-reviewed scientific and medical literature regarding the association between deployment-related stress and long-term adverse health effects in Gulf War veterans. Specifically, the committee was to study the physiologic, psychologic, and psychosocial effects of stress. Noted in

the committee's charge is that the study's findings are applicable not only to veterans of the 1991 Gulf War but to veterans of OEF and OIF.

To evaluate associations between deployment-related stress and adverse effects, the committee considered all studies that identified health effects found in military personnel deployed to a war zone. Deployment to a war zone would be used as a surrogate for deployment-related stress. The potential health effects considered included not only physiologic effects but psychologic effects, such as depression and PTSD, and psychosocial effects, such as marital conflict and incarceration. The committee also considered studies of deployed veterans with combat-related PTSD and associated health effects because PTSD can result only after exposure to a traumatic stressor and a war zone is rife with potentially traumatic events. In conducting its deliberations, the committee considered studies of veterans of World War II, the Korean War, the Vietnam War, the 1991 Gulf War, and OEF and OIF.

The committee sought to characterize and weigh the strengths and limitations of the available evidence regarding the association between deployment to a war zone and specific adverse health effects. The English-language scientific literature was searched to identify health effects in military veterans from World War II to the conflicts in Afghanistan and Iraq. Although most of the literature focused on U.S. military veterans, veterans from other countries were included. Over 3000 potentially relevant references were retrieved and assessed.

The committee used only peer-reviewed published literature as the basis of its conclusions. Committee members read each study critically and considered its relevance and quality. The committee did not collect original data, nor did it perform any secondary data analysis.

The committee also did not address policy issues—such as decisions regarding compensation, potential costs of compensation, or any broader policy implications of its findings—nor did it examine treatment approaches for any health effects.

EVALUATION CRITERIA

When the committee had obtained the studies that met its inclusion criteria, it was necessary to establish which papers would constitute the foundation of its conclusions. In its review of the literature, the committee divided the available studies into two categories: primary and secondary.

Primary Studies

The committee used primary studies as the basis of its evaluation and conclusions. A primary study demonstrates rigorous methods; for example, it includes details of its methods, has an appropriate control or reference group, has a sample size of at least 100, has the statistical power to detect effects, and includes reasonable adjustments for confounders. Ideally, it has information regarding a specific health effect and exposure. To consider a study as primary, the committee insisted that the health effect be diagnosed or confirmed by a clinical evaluation, specific laboratory test, hospital records, or other medical record or, for a psychiatric outcome, by standardized interviews. Primary studies included comparisons of veterans deployed to a war zone with their nondeployed counterparts and studies that evaluated health effects in veterans with deployment-related or combat-related PTSD.

Secondary, or Support, Studies

Secondary studies were less rigorous in their methods; for example, a study might have a small sample, not include a physician's examination or other appropriate evaluation method, or rely only on veterans' self-reports of symptoms or diseases. They might have been population-based surveys of veterans' responses to mailed questionnaires. The committee used those types of studies to support findings based on primary studies.

CATEGORIES OF ASSOCIATION

The committee agreed to base its conclusions on the categories of association that have been used by previous Committees on Gulf War and Health and other IOM committees that evaluated vaccine safety, effects of herbicides used in Vietnam, and indoor pollutants related to asthma. The categories are described below.

Sufficient Evidence of a Causal Relationship

Evidence is sufficient to conclude that there is a causal relationship between deployment to a war zone and a specific health effect in humans, and the evidence is supported by experimental data on humans or animals. The evidence fulfills the guidelines for sufficient evidence of an association (below) and satisfies several of the guidelines used to assess causality: strength of association, dose-response relationship, consistency of association, and temporal relationship.

Sufficient Evidence of an Association

Evidence is sufficient to conclude that there is an association; that is, a consistent association has been observed between deployment to a war zone and a specific health effect in human studies in which chance and bias, including confounding, could be ruled out with reasonable confidence. For example, several high-quality studies report consistent associations, are sufficiently free of bias, and include adequate control for confounding.

Limited but Suggestive Evidence of an Association

Evidence is suggestive of an association between deployment to a war zone and a specific health effect in human studies, but the body of evidence is limited by the inability to rule out chance and bias, including confounding, with confidence. At least one high-quality study reports a positive association that is sufficiently free of bias and includes adequate control for confounding, and other corroborating studies provide support for the association but are not sufficiently free of bias, including confounding. Alternatively, several studies of lower quality might show a consistent association, and the results are probably not due to bias, including confounding.

Inadequate/Insufficient Evidence to Determine Whether an Association Exists

Evidence is of insufficient quantity, quality, or consistency to permit a conclusion regarding the existence of an association between deployment to a war zone and a specific health effect in humans.

Limited/Suggestive Evidence of No Association

Evidence is consistent in not showing a positive association between deployment to a war zone and a specific health effect after exposure of any magnitude. A conclusion of no association is inevitably limited to the conditions, magnitudes of exposure, and length of observation in the available studies. The possibility of a very small increase in risk after exposure cannot be excluded.

LIMITATIONS OF VETERAN STUDIES

Few of the studies reviewed by the committee measured combat exposure or the level of stress experienced by military personnel during deployment to a war zone. Even in the studies that did assess combat exposure, using questionnaires or scales, researchers asked whether an exposure occurred (for example, had a soldier fired on the enemy) rather than the degree to which the veteran may have found the experience to be stressful. Few studies attempted to determine the effects of repeated or combined exposures, such as exposure to extreme heat, to chemical protective gear, and to shooting at an enemy.

Another limitation of many of the studies was their retrospective design, which resulted in an inability to distinguish whether a health effect existed before or was a consequence of deployment. Further limitations include the use of self-report questionnaires to assess health effects and exposure; such questionnaires can lead to recall bias with regard to exposures or to inaccuracies in reporting health effects. For those reasons, the committee weighted more heavily the studies that included an examination by a health professional or other appropriate evaluation method. Similarly, for psychiatric disorders, such as PTSD, some studies relied only on symptom checklists to indicate the presence of the disorders rather than on a proper diagnostic examination by a health professional. Many studies had a selection bias in that health effects were assessed in veterans who were in treatment groups, such as inpatients or outpatients at PTSD clinics, or were selected from registries of veterans established by VA. In addition, sufficient time might not have passed since deployment to detect the development of some health outcomes, for example, cancer or heart disease, particularly in OEF and OIF veterans.

DEPLOYMENT-RELATED STRESSORS

Exposure to combat has been described as one of the most intense stressors that a person can experience; for many people, combat is the most traumatic event of their life.

Deployment stressors in the Persian Gulf War included being in the vicinity of a Scud missile explosion, contact with prisoners of war or dead animals, direct combat duty, witnessing the death of a person, being exposed to dismembered bodies or maimed soldiers, coming under small-arms fire, having artillery close by, and fear of being wounded. It was found that military personnel in the Gulf War were at greatest risk for stress when their work was hazardous and

they anticipated exposure to chemical warfare; the risk increased with time spent in the field and exposure to the dead and wounded. Another stressor was the feeling that they were deserting their families at a time of need.

In OEF and OIF, many of the stressors are more reminiscent of the Vietnam War than of the 1991 Gulf War or World War II. With the defeat of the Iraqi Army and later sectarian violence, U.S. troops have been subjected to guerilla warfare and terrorist actions from civilian insurgents and militias, particularly the use of improvised explosive devices. Soldiers must be constantly on guard, and all civilians must be viewed with caution. Department of Defense (DoD) surveys of Army soldiers and Marines stationed in Iraq found that exposure to combat was the critical determinant of a soldier's or Marine's mental health.

THE STRESS RESPONSE

A person exposed to a stressor, deployment-related or not, may experience a stress response. The word *stress* is used in many contexts and has a variety of meanings. It is often used to describe a situation characterized by real or perceived threats, but it is also commonly used to refer to the body's response to such threats. Thus, *stress* has been used both to describe the environmental events (the stressors) that trigger responses and to refer to the resulting changes (stress response) that occur in the brain and the rest of the body.

The stress response is a coordinated set of interactions among multiple organ systems in the body, including the brain, gut, heart, liver, immune system, thyroid, adrenals, pituitary, gonads, bone, and skin. In response to a stressor, the body initiates an acute stress response. Acute stress responses are usually adaptive, preparing the body for "fight or flight." After exposure to the stressor has ended, the acute stress response subsides, and the body returns to its normal state. However, if the body's reactions persist after the stressor has ended, a chronic stress response can develop, which can be maladaptive and result in feelings of anxiety and lack of control and chronic health effects. Stressors can also lead to adverse psychosocial effects—such as marital conflicts and homelessness—concurrently with or after the development of health effects. Whether the stress response leads to adverse health effects either in the short term (hours to days) or in the long term (months to years) is determined by a number of factors, including the intensity and duration of the stressful experience, the effects of previous stressors, and risk factors (such as genetic susceptibility or a history of a psychiatric disorder) and protective factors (such as military training or supportive family and social environment). Thus, each person's response to stress can be modified on the basis of the specific deployment-related stressors, the complex nature of the stress response, and risk and protective factors.

POSTTRAUMATIC STRESS DISORDER

It is widely recognized that soldiers can suffer psychologic consequences during and after combat. After the Vietnam War, research demonstrated that many veterans, particularly those exposed to severe war-related trauma, and such other traumatized populations as Holocaust survivors, suffered from chronic psychologic problems that often resulted in social and occupational dysfunction. The constellation of symptoms that has come to be known as PTSD is an anxiety disorder whose occurrence is precipitated by exposure to a traumatic event. PTSD

was formally recognized as a psychiatric diagnosis in the third edition of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-III)*, published in 1980.

Characterized by symptoms of hyperarousal, numbing or avoidance, and re-experiencing of the traumatic event, PTSD may be evident shortly after exposure to a traumatic event or may take years for the veteran to have sufficient symptoms to meet the diagnostic criteria; once developed, the symptoms may persist for many years. PTSD, or symptoms associated with it, has been reported in veterans of World War II, the Korean War, the Vietnam War, the Gulf War, and OEF and OIF. The prevalence of PTSD in veterans increases as combat exposure increases, in some cases showing a dose-response relationship. PTSD is also highly comorbid with other psychiatric disorders, particularly major depression, general anxiety, and substance-use disorders. The presence of comorbid disorders increases the difficulty of diagnosing PTSD. PTSD is also associated with increased reporting of symptoms, medical conditions, and poor health in veterans. The *DSM-IV* requires that a diagnosis of PTSD include “clinically significant distress and/or impairment in social, occupational, and/or other important areas of functioning.” Veterans with PTSD report more disability and impaired functioning than those without PTSD.

Although military personnel may be exposed to identical stressors during their deployment to a war zone, their short-term and long-term responses to those stressors will vary. The variation is due to a host of individual risk factors and protective factors that influence the likelihood of long-term health effects after the exposures. The committee found that combat and being physically wounded were among the most significant risk factors for PTSD or other psychiatric disorders. Other important risk factors include childhood maltreatment, the presence of a pre-existing psychiatric disorder, poor social support on returning home, negative coping styles, being a member of a minority group, and lack of hardiness. Protective factors include better education, higher military rank, having a stable family life, and having a sense of control.

HEALTH EFFECTS

The committee reviewed numerous epidemiologic studies to arrive at conclusions about association. It weighed the strengths and limitations of all the epidemiologic studies and reached its conclusions by interpreting the data in the entire body of reviewed literature. It assigned each health outcome being considered to one of the five categories of association according to the specific criteria set forth above. The committee also considered health effects of PTSD. Its findings about the strength of the associations between deployment to a war zone, as a surrogate for deployment-related stress, and various health effects are summarized in Table S-1.

SUMMARY OF CONCLUSIONS

Table S-1 provides a summary of the committee’s conclusions for each health effect discussed in the report by category of association. No health effects were found for two categories of association, sufficient evidence of a causal relationship and limited/suggestive evidence of no association. Of all the long-term health effects reviewed, the strongest findings were on psychiatric disorders, including PTSD, anxiety, and depression. Alcohol abuse, suicide and accidental death in the early years after deployment, and marital and family conflict also appear to be adverse sequelae of deployment-related stress.

The committee found limited but suggestive evidence of an association between deployment-related stress and chronic fatigue syndrome, fibromyalgia and chronic widespread pain, gastrointestinal symptoms, skin disorders, incarceration, drug abuse, and increased symptom reporting, unexplained illness, and chronic pain.

Finally, it should be repeated that the committee was charged with reviewing scientific data, not with making recommendations regarding VA policy.

TABLE S-1 Summary of Findings Regarding the Association Between Deployment to a War Zone and Specific Health and Psychosocial Effects

Sufficient Evidence of a Causal Association

Evidence from available studies is sufficient to conclude that there is a causal relationship between deployment to a war zone and a specific health effect in humans. The evidence is supported by experimental data and fulfills the guidelines for sufficient evidence of an association (below). The evidence must be biologically plausible and satisfy several of the guidelines used to assess causality, such as strength of association, dose-response relationship, consistency of association, and temporal relationship.

- No effects.

Sufficient Evidence of an Association

Evidence from available studies is sufficient to conclude that there is a positive association. That is, a consistent positive association has been observed between deployment to a war zone and a specific health effect in human studies in which chance and bias, including confounding, could be ruled out with reasonable confidence. For example, several high-quality studies report consistent positive associations, and the studies are sufficiently free of bias and include adequate control for confounding.

- Psychiatric disorders, including PTSD, other anxiety disorders, and depressive disorders.
- Alcohol abuse.
- Accidental death in the early years after deployment.
- Suicide in the early years after deployment.
- Marital and family conflict.

Limited but Suggestive Evidence of an Association

Evidence from available studies is suggestive of an association between deployment to a war zone and a specific health effect, but the body of evidence is limited by the inability to rule out chance and bias, including confounding, with confidence. For example, at least one high-quality study reports a positive association that is sufficiently free of bias, including adequate control for confounding, and other corroborating studies provide support for the association (corroborating studies might not be sufficiently free of bias, including confounding). Alternatively, several studies of lower quality show consistent positive associations, and the results are probably not due to bias, including confounding.

- Drug abuse.
- Chronic fatigue syndrome.
- Gastrointestinal symptoms consistent with functional gastrointestinal disorders, such as irritable bowel syndrome or functional dyspepsia.
- Skin disorders.
- Fibromyalgia and chronic widespread pain.
- Increased symptom reporting, unexplained illness, and chronic pain.
- Incarceration.

TABLE S-1 Continued

Inadequate/Insufficient Evidence to Determine Whether an Association Exists

Evidence from available studies is of insufficient quantity, quality, or consistency to permit a conclusion regarding the existence of an association between deployment to a war zone and a specific health effect in humans.

- Cancer.
- Diabetes mellitus.
- Thyroid disease.
- Neurocognitive and neurobehavioral effects.
- Sleep disorders or objective measures of sleep disturbance.
- Hypertension.
- Coronary heart disease.
- Chronic respiratory effects.
- Structural gastrointestinal diseases.
- Reproductive effects.
- Homelessness.
- Adverse employment outcomes.

Limited/Suggestive Evidence of No Association

Evidence is consistent in not showing a positive association between deployment to a war zone and a specific health effect after exposure of any magnitude. A conclusion of no association is inevitably limited to the conditions, magnitudes of exposure, and length of observation in the available studies. The possibility of a very small increase in risk after deployment cannot be excluded.

- No effects.
-

RECOMMENDATIONS

The committee recommends that DoD conduct predeployment and postdeployment screening for medical conditions, including psychiatric symptoms and diagnoses, and for psychosocial status to help collect direct evidence about the causal nature of the effects of deployment-related stress. Predeployment screening would also help to identify at-risk personnel who might benefit from targeted intervention programs during deployment and would establish a baseline against which later health and psychosocial effects could be measured after deployment. Postdeployment screening and assessment would provide data that could be analyzed to determine the long-term consequences of deployment-related stress and would allow VA and DoD to implement intervention programs to assist deployed veterans in adjusting to postdeployment life. Such assessments should be made shortly after deployment and should identify those exposures most stressful to the veteran. The assessments should be made at regular intervals thereafter (such as every 5 years) to identify the long-term health and psychosocial effects. The committee further recommends that any longitudinal assessments also be conducted in a representative group of nondeployed veterans to allow appropriate comparisons between deployed and nondeployed veterans regarding health and psychosocial effects.

GULF WAR and HEALTH

VOLUME 6

PHYSIOLOGIC, PSYCHOLOGIC, AND PSYCHOSOCIAL EFFECTS OF DEPLOYMENT-RELATED STRESS

**Committee on Gulf War and Health: Physiologic, Psychologic, and Psychosocial
Effects of Deployment-Related Stress**

Board on Population Health and Public Health Practice

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The serpent has been a symbol of long life, healing, and knowledge among almost all cultures and religions since the beginning of recorded history. The serpent adopted as a logotype by the Institute of Medicine is a relief carving from ancient Greece, now held by the Staatliche Museen in Berlin.

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*“Knowing is not enough; we must apply.
Willing is not enough; we must do.”*

—Goethe



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This report has been reviewed in draft form by persons chosen for their diverse perspectives and technical expertise in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards of objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following for their review of this report:

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Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by **Dr. Charles E. Phelps**, University of Rochester, and **Dr. Harold C. Sox**, American College of Physicians/*Annals of Internal Medicine*. Appointed by the National Research Council and the Institute of Medicine, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the author committee and the institution.

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ACRONYMS

ACTH	Adrenocorticotrophic hormone, corticotropin
APA	American Psychiatric Association
ASI	Anxiety sensitivity index
AUDIT	Alcohol use disorder identification test
BIRLS	Beneficiary identification record locator subsystem
BNST	Bed nucleus of the stria terminalis
BSS	Body-system symptom
CAPS	Clinician-Administered PTSD Scale
CCEP	Comprehensive Clinical Evaluation Program
CDC	Centers for Disease Control and Prevention
CES	Combat Exposure Scale
CFS	Chronic fatigue syndrome
CHD	Coronary heart disease
CI	Confidence interval
CIDI	Composite International Diagnostic Interview
CNS	Central nervous system
COPD	Chronic obstructive pulmonary disease
CRH	Corticotropin-releasing hormone
CSF	Cerebrospinal fluid
CSMs	Cerebrospinal malformations
CTS	Conflict Tactics Scale
CVLT	California Verbal Learning Test
DIS	Diagnostic Interview Schedule
DMDC	Defense Manpower Data Center
DoD	Department of Defense
<i>DSM</i>	<i>Diagnostic and Statistical Manual of Mental Disorders III or IV</i>
GAD	Generalized anxiety disorder
GI	Gastrointestinal
HDL	High-density lipoprotein
HPA	Hypothalamus-pituitary-adrenal
HU13	Health Utilities Index Mark 3
HVVP	Hawaiian Vietnam Veterans Project
IBS	Irritable bowel syndrome
ICD	<i>International Statistical Classification of Diseases and Related Health Problems</i>

IEDs	Improvised explosive devices
IOM	Institute of Medicine
km	Kilometer
MDD	Major depression disorder
MHAT	Mental Health Advisory Team
MHM	Military History Measure
MMPI	Minnesota Multiphasic Personality Inventory
MPI	Martial Problem Index
MRI	Magnetic resonance imaging
MSAs	Metropolitan statistical areas
NART	National Adult Reading Test
NAS	National Academy of Sciences
NCHS	National Center for Health Statistics
NCO	Noncommissioned officer
NCS	National Comorbidity Survey
NHANES	National Health and Nutrition Examination Survey
NHL	Non-Hodgkin's lymphoma
NSVG	National Survey of the Vietnam Generation
NVVRs	National Vietnam Veterans Readjustment Study
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OR	Odds ratio
PASAT	Paced Auditory Serial Addition Test
PB	Pyridostigmine bromide
PIR	Proportional incidence rate
PMR	Proportional morbidity ratio
PPI	Parental Problem Index
PTSD	Posttraumatic stress disorder
RR	Relative risk
SCID	Structured Clinical Interview for <i>DSM-III</i> or <i>IV</i>
SE	Standard error
SF-36	36-Item Medical Outcomes Study Short-Form
T3	Triiodothyronine
T4	Thyroxine
TSH	Thyroid-stimulating hormone
UK	United Kingdom
UN	United Nations
VA	Department of Veterans Affairs

ACRONYMS

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VES	Vietnam Experience Study
VET Registry	Vietnam-Era Twin Registry
vs	Versus
WAIS-R	Wechsler Adult Intelligence Scale-revised
WCST	Wisconsin Card Sorting Test

PREFACE

Deployment to a war zone has a profound impact on the lives of many of the troops who are deployed to foreign soil and on their family members. Needless to say, numerous stressors are associated with deployment, from terrifying concerns about surviving, being taken prisoner, and being tortured to the horrific possibility of seeing friends die, being maimed, and handling dead bodies. Less traumatic but more pervasive stressors include anxiety about home life, such as loss of a job and income, impacts on relationships, and absence from family.

The effects of deployment-related stressors on a veteran's health during and after deployment are numerous. When sudden and life-threatening stressors are encountered, the body will typically react with an acute "flight or fight" response that subsides when the stressor goes away. If the stressor or the acute response persists, the body may react with a more prolonged stress response that can lead to harmful long-term effects on health. The focus of this report, by the Institute of Medicine (IOM) Committee on Gulf War and Health: Physiologic, Psychologic, and Psychosocial Effects of Deployment-Related Stress, is the long-term effects of deployment-related stress. What happens to military personnel when they are subjected to the many stressors that occur in a war zone?

The U.S. Department of Veterans Affairs and Congress have secured the assistance of IOM in evaluating the scientific literature regarding an association between deployment-related stressors and health effects. Congress's request regarding the possible association between illness and exposure to stressors in the Gulf War is similar to its approach after the Vietnam War to exposure to Agent Orange and after the 1991 Persian Gulf War to exposure to numerous biologic and chemical agents. Although seemingly straightforward conceptually, this task has proved to be much more difficult than previous studies. The committee discussed how to define deployment-related stress, the types of stressors encountered, and how they might be assessed or measured.

In this report, the committee equated deployment-related stress with being deployed to a war zone, although it recognized that not everyone deployed to a war zone would respond to stressors in the same way and that not everyone would necessarily find a particular event stressful. The reaction to deployment-related stressors would depend on numerous factors that were present before, during, and after deployment. Stressors that people experienced in childhood, their interactions with friends and family, and whether they were wounded during deployment would all play a role in the nature of the response. The committee also understood that some military personnel would have minor reactions and transient health effects, some would have severe reactions and more chronic health effects, and some would go on to develop posttraumatic stress disorder (PTSD), which could be associated with additional health effects. That approach is detailed in the committee's report.

The committee deliberated for many months and met 14 times. It reviewed all the studies of health effects in veterans deployed to a war zone and found that most studies did not measure the stressors of war (although that was not required for inclusion in the committee's analysis), and that the ones that did measure deployment-related stress were most often related to PTSD. The committee noted that although experimental data from studies in animals indicated

numerous health effects associated with various types of stressors, the human literature is much more challenging to interpret.

I am deeply appreciative of the hard work of our committee members: Kathryn Basham, Evelyn Bromet, Gregory Burke, Dennis Charney, Michael Davis, Douglas Drossman, Dwight Evans, Vincent Felitti, Janice Krupnick, William Malarkey, Bruce McEwen, Thomas Pickering, Jerrold Rosenbaum, and Timothy Walsh, and of our expert consultants Carol North, Kerry Knox, and Miriam Davis. The committee would like to thank Jack Gorman for his thoughtful input. Although the committee developed conclusions independently of input from IOM staff, we deeply appreciate their hard work and attention to detail and the extensive research that they conducted to ensure that we had all the information that we needed from the outset. It has been a privilege and a pleasure to work with the IOM staff directed by Roberta Wedge and Carolyn Fulco. Without them, this report would not have been possible. Most of all, our committee appreciates the veterans who have served in this country's wars. It is for them that we do this work, and we hope that this report will inform those who have given so much to our nation.

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