

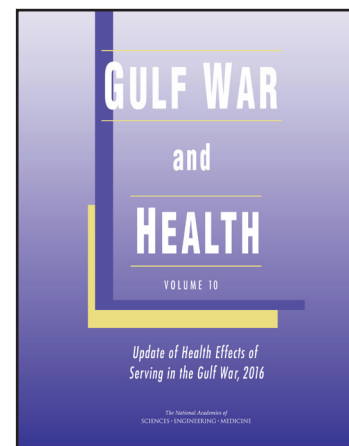
Gulf War and Health: *Volume 10:* Update of Health Effects of Serving in the Gulf War, 2016

In response to the invasion of Kuwait by Iraq in August 1990, the United States led a coalition of 34 countries in a buildup of forces in the Persian Gulf called Operation Desert Shield. It was followed by Operation Desert Storm, which began in January 1991 with an air offensive and a 4-day ground war and was over by the end of February. A ceasefire was signed in April 1991. Almost 700,000 U.S. troops were deployed to the Persian Gulf region at the height of the buildup. Service members who were deployed were exposed to many hazardous agents and situations, both known and unknown.

These exposures included chemical and biological agents, mandatory vaccines, oil-well fire smoke, dust, high ambient temperatures and heat stress, pesticides, and pyridostigmine bromide (PB), a prophylactic agent against potential nerve agent exposure. Although the war was brief with relatively few injuries and deaths among coalition forces, a substantial number of veterans suffers from a variety of health problems that have persisted for more than 25 years.

In response to the variety of health problems and symptoms reported by veterans, Congress passed two laws directing the Department of Veterans Affairs (VA) to contract with the Institute of Medicine (IOM) of the National Academies of Sciences, Engineering, and Medicine to review and evaluate the scientific and medical literature regarding associations between illness and exposure to toxic agents, environmental or wartime hazards, or preventive measures and vaccines associated with Gulf War service. Those findings were published in nine prior reports in the series *Gulf War and Health*.

In this tenth and final report in the series, an expert committee assembled by the IOM reviews, evaluates, and summarizes the available scientific and medical literature regarding health effects in the 1990-1991 Gulf War veterans, with special attention to neurological disorders (e.g., Parkinson's disease, multiple sclerosis, amyotrophic lateral sclerosis, and migraines), cancer (especially brain cancer and lung cancer), and chronic multisymptom illness (Gulf War illness). The resulting report, *Gulf War and Health: Volume 10: Update of Health Effects of Serving in the Gulf War, 2016*, updates two previous reviews published in 2006 (Volume 4) and 2010 (Volume 8) and provides recommendations for future research efforts on Gulf War veterans.



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HEALTH CONDITIONS

In spite of a thorough literature search, little new information was available for each health outcome being assessed. The conclusions reached in this volume are largely consistent with those in the previous review (Volume 8). For a detailed listing of the committee's conclusions regarding associations between Gulf War deployment and specific health conditions, and to read the committee's recommendations, please see the "Conclusions and Recommendations" insert to this report in brief.

Veterans who were deployed to the Gulf War do not appear to have an increased risk for many long-term health conditions with the exceptions of PTSD, chronic fatigue syndrome, functional gastrointestinal conditions, generalized anxiety disorder, depression, substance abuse, and, most notably, Gulf War illness. These disorders are similar in that they have no objective medical diagnostic tests and are diagnosed based on subjective symptom reporting. These associations emphasize the interconnectedness of the brain and physical functioning.

The report also contains a review of animal studies that assessed multiple chemical and other exposures (e.g., exposure to PB, pesticides, and stress at the same time or in close succession). It finds that animal studies have not been successful in suggesting a mechanism by which deployment exposures during the Gulf War might lead to Gulf War illness and that development of an animal model of Gulf War illness may not be possible.

For future conflicts, collecting exposure information before, during the deployments, and afterwards, preferably using environmental and individual

monitoring devices and military records (both health and administrative) to capture such information as vaccines, troop location, and toxicant concentrations, would make the data less subject to recall bias and permit a more accurate assessment of actual exposures.

Gulf War Illness

The complex clusters of symptoms (such as headache, joint and back pain, fatigue and sleep problems, and cognitive dysfunction) reported by deployed Gulf War veterans has come to be known as Gulf War illness. Research to date has not identified a single mechanism that can explain the multitude of symptoms seen in Gulf War illness. Additionally, it is unlikely that a single definitive causal agent will be identified this many years after the war.

Even though many symptoms of Gulf War illness are shared by psychological conditions (such as chronic pain and sleep disturbances), most studies have excluded the psychological aspects of Gulf War illness. The committee concludes that it is time research efforts move forward and focus on the interconnectedness of the brain and body when seeking to improve treatment of veterans for Gulf War illness. It is clear that multiple organ systems in the body, including the brain, gut, heart, liver, immune system, thyroid, adrenals, pituitary, gonads, bone, and skin, are affected in Gulf War illness. The report states that to ignore available treatments that may improve the functioning of any of these organ systems would be to do a disservice to our Gulf War veterans.

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Neurologic Conditions

There is little new information pertaining to multiple sclerosis, Parkinson's disease, Alzheimer's disease, or migraines. ALS is the only neurologic disease for which there is limited/suggestive evidence of an association with deployment to the Gulf War. Although Gulf War deployment was associated with increased risk of developing ALS and increased ALS severity, no association with ALS mortality (a uniformly fatal disease) was found. Given this discrepancy, further follow-up is warranted. The Gulf War veteran population is still young with respect to the development of other neurodegenerative diseases; therefore, the effects of deployment on their incidence and prevalence may not yet be obvious.

Lung and Brain Cancer

Lung and brain cancer are of special concern to Gulf War veterans. Although this and prior committees found no evidence that Gulf War veterans were at increased risk for cancer in the approximately 10–15 years after the war, that time period may not have been adequate to account for the long latency of cancer.

The new studies identified by the committee found no statistically significant increase in the risk of brain cancer in deployed Gulf War veterans compared with their nondeployed counterparts.

There continues to be inadequate/insufficient evidence to determine whether deployed Gulf War veterans are at increased risk of having any cancer, including lung and brain cancer. The relative rarity of cancers such as brain cancer argues for studies with adequate power to detect them. This may require pooling data where feasible and using a variety of data sources such as state cancer registries.

Other Health Conditions

In contrast to cancer, sufficient time has elapsed to determine that Gulf War deployed veterans do not have an increased incidence of circulatory, hematologic, respiratory, musculoskeletal, structural gastrointestinal, genitourinary, reproductive, and chronic skin conditions compared with their nondeployed counterparts. As Gulf War veterans age, it will be more difficult to differentiate the effects of deployment from the natural effects of aging on morbidity and mortality.

Because the association of deployment to the Gulf War with PTSD, anxiety disorders, substance abuse, and depression is well established, further studies to assess whether there is an association are not warranted.

There are no data on the delayed effects of Gulf War exposures, such as nerve agents and PB, to indicate that such toxic agents would remain in the body and would be able to cause disease this long after the Gulf War. Thus, with the exception of diseases with long latency periods such as cancer, it is not reasonable to expect increased risks of diseases associated with toxic exposures now. However, the committee also suggested that veterans who had exposure to depleted uranium should continue to be monitored for adverse health conditions.◆◆

Committee on Gulf War and Health, Volume 10: Update of Health Effects of Serving in the Gulf War

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