



Gulf War and Health

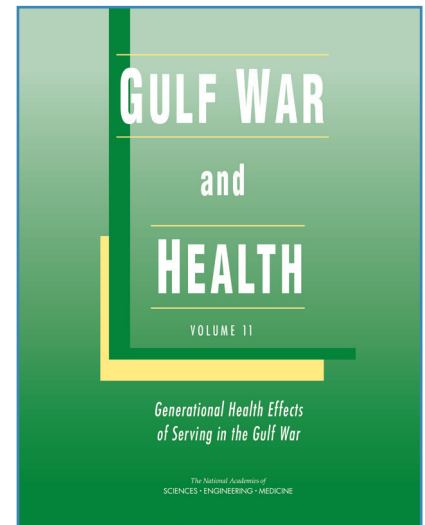
Volume 11: Generational Health Effects of Serving in the Gulf War

Almost 700,000 U.S. troops were deployed to the Persian Gulf region during the height of Operation Desert Shield and Operation Desert Storm in 1990–1991. The U.S. military engaged in further conflicts in the Middle East following the terrorist attacks of September 11, 2001, with troops stationed in and around Afghanistan and in Iraq. The U.S. military mission in Iraq ended in 2011; the U.S. mission in Afghanistan continues.

In any war, deployed service members may be exposed to many hazardous agents and situations—some intentional and many unknown. Such exposures may include chemicals that are used in everyday civilian life, such as pesticides and solvents, but the duration or frequency of their use may be different in deployment settings. Other potential exposures include chemical and biological agents, mandatory vaccines, oil-well fire smoke, dust, high ambient temperatures and heat stress, depleted uranium (DU), and pyridostigmine bromide (PB), a prophylactic agent against nerve agent exposure.

In response to health concerns of Gulf War veterans, Congress in 1998 directed the Department of Veterans Affairs (VA) to contract with the National Academies of Sciences, Engineering, and Medicine to evaluate the scientific and medical literature regarding associations between illness and exposure to the toxic agents, environmental and wartime hazards, and preventive medicines and vaccines associated with Gulf War service. Since then, the National Academies has prepared more than ten reports, the *Gulf War and Health* series, focused on the health of Gulf War veterans.

Gulf War and Health: Volume 11 assesses the available evidence on the reproductive effects related to exposures that may have occurred during the Gulf War and Post-9/11 conflicts, as well as potential effects of those exposures on the health of veterans' children. The report provides guidance to VA on future research and looks at potential ways researchers may determine if there are health effects in the children or grandchildren of veterans of any era related to their parents' or grandparents' deployment exposures.



THE COMMITTEE'S APPROACH

The committee began its deliberations with public meetings to hear from representatives of VA, academic researchers, interested veterans, and veterans' service organizations and to gather information from representatives of the National Institute for Environmental Health Sciences and its affiliated National Toxicology Program, the Centers for Disease Control and Prevention, and the Department of Defense. That input helped the committee understand VA's needs, appreciate the veterans' concerns, and be cognizant of complementary efforts already under way at other organizations.

The committee then considered what reproductive, developmental, and generational effects were already associated with the Gulf War and Post-9/11 toxicants and what data and knowledge gaps needed to be addressed to understand those effects. These data and information were then used to develop approaches for studying and monitoring potential health problems related to veterans' deployments and their impact on children and grandchildren. The committee's approach to its tasks was driven by the literature as well as by the committee's expertise, and it followed the evaluation process established by prior *Gulf War and Health* committees.

Extensive searches of the scientific literature targeted studies of the reproductive health of Gulf War or Post-9/11 veterans published since the last update; studies that looked at reproductive effects associated with any toxicants of concern; and studies of developmental or other health outcomes in children or grandchildren associated with parental exposures to those toxicants.

FINDINGS AND CONCLUSIONS

The committee organized the toxicants of concern into four groups:

- deployment-related exposures, including deployment itself, vaccines, chemical warfare agents, infectious diseases, depleted uranium, hexavalent chromium, and PB;
- pesticides;
- combustion products and fuels; *and*
- solvents.

No toxicant had sufficient evidence of a causal association between exposure and reproductive or developmental effects. Nor did any toxicant have limited/suggestive evidence of no association between exposure and reproductive or developmental effects.

For a full overview of the committee's conclusions for each toxicant of concern, please see the Summary Table found at nationalacademies.org/GulfWarHealth11.

These conclusions need to be interpreted within the broader context of both the veterans' and their descendants' exposures over the courses of their lives. Exposures across the life course, beginning in utero, can have an impact on health, including that of future children. Those exposures, such as nutritional exposure and exposure to toxicants, may interact with one another and be influenced by a person's genome and epigenome. Such changes are being studied, but at present there is not enough evidence to link any deployment exposures to epigenetic effects.

FUTURE DIRECTIONS

To help determine if veterans' descendants are at risk for health effects resulting from the veterans' exposures during deployment, the committee has proposed creating a health monitoring and research program (HMRP). The program would comprise three arms: monitoring the health of veterans and their descendants over time; epidemiologic studies to examine groups of veterans and their descendants for health outcomes of concern; and basic and translational research to help address data and knowledge

gaps. Recruiting and enrolling, engaging with, and collecting data from veterans, their partners, and the children themselves will be essential elements of the HMRP. Publication of the program's results will ensure that veterans and their descendants are aware of the findings, positive or negative, that may affect their health and well-being. The report describes in detail the committee's framework for development of an HMRP.

The committee also lays out an agenda for basic and translational research on generational effects. Basic and translational research that uses cells and tissues as well as whole animals can provide powerful opportunities to gain important insights. The results of these studies must then be extrapolated to humans to enhance understandings of the reproductive, developmental, and generational effects of toxicant exposures.

During the course of the committee's deliberations, several scientific priorities became evident. Addressing these priorities will be critical to implementing a functional and useful HMRP and a concrete agenda to answer questions about the reproductive, developmental, and generational health effects of deployment exposures. These priorities include the following:

- The collection, storage, and maintenance of comprehensive baseline and longitudinal data and biospecimens from veterans, their partners, and their descendants;
- Detailed exposure characterization and assessment during and after deployment; *and*
- The development, evaluation, standardization, and interoperability of biomarkers of exposure, susceptibility, and biological effects.

CONCLUSION

The committee commends the efforts of VA and Congress to address veterans' concerns about generational health effects. Moving forward demands an understanding of certain critical issues that will define the success of the program. The knowledge that arises from studying generational effects will ultimately be rewarded with new understanding of veterans' exposures, their reproductive health, and the health of their children and grandchildren. Importantly, this knowledge and understanding will be relevant to the health of all Americans—now and for future generations.

**Committee on Gulf War and Health, Volume 11:
Generational Health Effects of Serving in the Gulf War**

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