

FEATURED STUDY FROM THE INSTITUTE OF MEDICINE

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Long-Term Health Consequences of Exposure to Burn Pits in Iraq and Afghanistan

Foreword: It is well understood how hazardous combat operations can be as a result of the kinetic forces associated with modern weaponry. What is less appreciated is how other environmental factors come into play that further complicate and increase operational hazards. Those environmental factors may include very hot humid or frigid climates, high elevations, or locations far under the sea. Or the environment may contain disease vectors that can ravage the military forces “visiting” their domains. In addition, there are many sources of toxic chemical, biological, or radiological agents—both manmade and natural—that may be lurking in the background. This latter type of threat is examined by an IOM committee in response to a request from the Department of Veterans Affairs to examine the health consequences to military forces deployed in proximity to potentially hazardous burn pits in Iraq and Afghanistan.

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INTRODUCTION

During deployment to a war zone, military personnel are exposed to a variety of environmental hazards, such as dust, intense heat and sunlight, emissions from kerosene heaters, pesticides, and depleted uranium. Exposure to many such hazards has been associated with long-term adverse health outcomes. Many military personnel returning from the current conflicts in Iraq and Afghanistan are reporting health problems that they attribute to their exposure to emissions from the burning of waste in open-air “burn pits” on military bases. Throughout the recent and ongoing operations in Iraq and Afghanistan, the military has routinely used burn pits to dispose of waste.

In response to concerns expressed by military personnel and veterans, their families, and Congress, the Department of Veterans Affairs (VA) asked the Institute of Medicine (IOM) to explore the use of burn pits in the military and

determine the long-term health effects of exposure to burn pits in Iraq and Afghanistan.

USE OF MILITARY BURN PITS

Open-air waste burning has long been used by the military when other waste-disposal options have not been available. Technologic advances in recent military conflicts mean that new items are being burned—plastic bottles and electronics, for example—and the burning of such items presents new health risks. The uncontrolled burning of waste in pits has been the primary solid-waste management solution in Afghanistan and Iraq from the beginning of the conflicts in 2001 and 2003, respectively. The use of burn pits by the U.S. military in those countries was restricted in 2009. By December 31, 2010, their use in Iraq had gradually been phased out, but 197 burn pits were still operating in Afghanistan as of January 2011.

In response to personnel complaints of odor, poor visibility, and health effects attributed to burn pit emissions, the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM, now the U.S. Army Public Health Command) and the Air Force Institute for Operational Health conducted ambient-air sampling and screening health-risk assessments of burn pit exposures at Joint Base Balad (JBB), near Baghdad, in 2007 and again in 2009. The assessments were designed to detect potentially harmful inhalation exposures of personnel at JBB to chemicals expected to be released by the burn pit. The CHPPM reports indicated that the risk of acute health effects of all chemicals detected, except coarse particulate matter (PM), was low and that long-term health risks were “acceptable” (i.e., for noncancer endpoints a hazard index of less than 1.0; for cancer endpoints a risk ranging from 1 in 10,000 to 1 in 1,000,000 or lower).

AIR MONITORING DATA FOR JBB

The committee received raw air-monitoring data on JBB from CHPPM to use in its analysis of the expected sources and nature of air pollutants. The monitoring data were used to compare the average chemical composition of air pollution at different locations on the base and with pollution profiles for other locations around the world. Of the three monitoring locations at JBB, one was considered a

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background site (a mortar pit) that was usually upwind of the burn pit, and the other two locations (H-6 housing/CASF and a guard tower and transportation field) were considered to be downwind of the burn pit.

Sources of regionally and locally generated air pollutants at JBB include windblown dust, local combustion sources, and volatile evaporative emissions. The local combustion sources include the burn pit or incinerators for refuse, compression ignition vehicles, aircraft engines, diesel electric generators, and local industry and households. Volatile evaporative emissions come primarily from refueling and other fuel management activities on the base. Each of those sources emits a complex mixture of particulate and gaseous pollutants that include volatile organic compounds (VOCs), particle-phase and vapor-phase semivolatile organic compounds, metals, and PM. Ambient air concentrations of polychlorinated dibenzo-*p*-dioxins and dibenzo-*p*-furans (PCDDs/Fs), polyaromatic hydrocarbons (PAHs), and VOCs were measured at JBB, and the committee has used the values to estimate the effect of the burn pit on air pollution at JBB. Sampling data were evaluated for composition and concentrations at each of the sites with a goal of determining differences that may be attributed to the burn pit and other known sources. The conclusions of the analyses are as follows:

- Background ambient-air concentrations of PM at JBB were high, on the average higher than U.S. air pollution standards. The high background PM concentrations were most likely derived from local sources, such as traffic and jet emissions, and regional sources, including long-range anthropogenic emissions and dust storms, although emissions from the burn pits may have contributed a small amount of PM.

PCDDs/Fs were detected at low concentrations in nearly all samples, and the burn pit was probably the major source of these chemicals. The toxic equivalents of the concentrations were higher than those in the United States and even in polluted urban environments worldwide, but they were below those associated locally with individual sources.

- Ambient VOC and PAH concentrations were similar to those reported for polluted urban environments outside the United States, and the major sources of those pollutants were regional background, ground transportation, stationary power generation, and the JBB airport.

The committee's conclusions suggest that the greatest pollution concern at JBB may be the mixture of regional background and local sources—other than the burn pit—that contribute to high PM.

HEALTH EFFECTS OF AIR POLLUTANTS AND COMBUSTION PRODUCTS

The committee reviewed the scientific literature on the toxicity and long-term health effects of 51 pollutants identified in the air sampling at JBB, regardless of exposure level and pathway.

A wide array of health effects has been observed in humans and animals after exposure to the specific air pollutants detected at JBB, including eye and throat irritation, organ weight changes, histopathologic changes (e.g., lesions and hyperplasia), inflammation, and reduced or impaired function. The effects have been found in many organs and systems, including adrenal glands, blood, lungs, liver, kidneys, stomach, spleen, and cardiovascular, respiratory, reproductive, and central nervous system.

Given that very few health studies have been conducted on military personnel exposed to the burn pits in Iraq and Afghanistan burn, the committee approached its review of the long-term health effects of combustion products by studying two occupational groups likely to have exposures most similar to military personnel—firefighters and incinerator workers. Although these studies have limitations and uncertainties, the committee concluded that there is inadequate/insufficient evidence of an association between exposure to combustion products and cancer, respiratory disease, circulatory disease, neurologic disease, and adverse reproductive and developmental outcomes in the populations studied. However, there is limited/suggestive evidence of an association between exposure to combustion products and reduced pulmonary function in the populations studied. The committee further concluded that additional study of health effects, specifically in veterans who served in Afghanistan and Iraq, is necessary.

CONCLUSION

In light of its assessment of health effects that may result from exposure to the air pollutants detected at JBB and its review of the literature on long-term health effects in surrogate populations, the committee is unable to say whether long-term health effects are likely to result from exposure to emissions from the burn pit at JBB. However, the committee's review of the literature and the air-sampling data from JBB suggests that service in Iraq or Afghanistan—that is, a broader consideration of air pollution than exposure only to burn pit emissions—might be associated with long-term health effects, particularly in highly exposed populations (such as those who worked at the burn pit) or susceptible populations (e.g., those who have asthma), mainly because of the high ambient concentrations of PM from both natural and anthropogenic, including military, sources. If that broader exposure to air pollution turns out to be sufficiently high, potentially related health effects of concern are respiratory and cardiovascular effects and cancer. Susceptibility to PM health effects could be exacerbated by other exposures, such as stress, smoking, local climatic conditions, and coexposures to other chemicals that affect the same biologic or chemical processes.

The committee stressed that none of the individual chemical constituents of the combustion products emitted at JBB appears to have been present at concentrations likely to be responsible for the adverse health outcomes studied in this

report. However, the possibility of exposure to mixtures of those chemicals raises the potential for health outcomes associated with cumulative exposure to combinations of the constituents in burn pit emissions.

Finally, given an awareness of the data gaps and analytic limitations in the studies reviewed for this report, the committee recommended a 3-tiered prospective study of the long-term health effects of exposure to burn-pit emissions in military personnel deployed at JBB.

that will provide recommendations on analyzing, improving, and utilizing information obtained by the AH&OBPR. The committee will first analyze the data collected in the initial months of the registry's operation and then identify improvements to the collection and maintenance of such information and offer recommendations regarding the means of addressing the medical needs of exposed individuals. The IOM will submit the Phase 1 report to the Secretary of the VA for submission to Congress in 2016.

For more information, visit www.iom.edu/burnpits

IMPACT OF THE BURN PITS REPORT

The VA, in coordination with the Department of Defense, established the Airborne Hazards and Open Burn Pit Registry (AH&OBPR) in 2013 in response to the IOM's report. The registry collects self-reported exposure and Veterans Health Administration health outcome data of active-duty service members and veterans who were deployed to the Southwest Asia theatre of operations on or after August 20, 1990, or Afghanistan or Djibouti on or after September 11, 2001. The VA is currently sponsoring a 2-phase study by the IOM



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