



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

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

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Statement of Task

Determine the long-term health effects from exposure to burn pits in Iraq and Afghanistan. Specifically, the committee will use the Balad burn pit in Iraq as an example and examine existing literature that has detailed the types of substances burned in the pits and their by-products. The committee will also examine the feasibility and design issues for an epidemiologic study of veterans exposed to the Balad burn pit.

The committee will explore the background on the use of burn pits in the military. Areas of interest to the committee might include but are not limited to investigating:

- Where are burn pits located, what is typically burned, and what are the by-products of burning;
- The frequency of use of burn pits and average burn times; and
- Whether the materials being burned at Balad are unique or similar to burn pits located elsewhere in Iraq and Afghanistan.

Committee's Approach

Used a modified risk assessment approach

Data sources:

- Peer-reviewed literature;
- DoD information, particularly:
 - Screening Health Risk Assessment: Burn Pit Exposures; Balad Air Base, Iraq (Air Force Institute for Operational Health and Army Center for Health Promotion and Preventive Medicine) and two addenda, plus raw air monitoring data collected for RA in 2007 and 2009;
 - Epidemiologic Studies of Health Outcomes among Troops Deployed to Burn Pit Sites
- Government documents, reports, and Congressional testimony
- Relevant NRC and IOM reports; particularly:
 - NRC Review of the DoD Enhanced Particulate Matter Surveillance Program Report
- Other literature

Committee's Approach

- Collect data related to exposures and health effects reported for the populations at JBB including air monitoring data from JBB
- Identify potential health effects associated with air pollutants found in emissions from burn pits
- Assess health outcomes in other human populations potentially exposed to some of the contaminants found in burn pit emissions
- Synthesize and summarize key findings and data gaps
- Examine feasibility issues and describe design elements for a future epidemiologic study of the health of veterans exposed to burn pit emissions

Burn Pit Use and History

- Open air burning of wastes is common practice on military bases; incinerators have replaced them on many bases
- 8-10 lbs of waste generated per person per day in theater
- JBB burned 100-200 tons of waste per day in 2007 (exact amounts are not available)
- Composition of waste stream at JBB is unknown to the committee but DoD study of burn pits in Iraq and Afghanistan indicate 81–84% is combustible material (composition unknown)
- US military burn pit operations began in 2003; by October 2009, replaced by 3 incinerators

CHPPM Assessments at JBB

- In response to complaints about smoke from the pit and increased respiratory problems, CHPPM and the Air Force Institute for Operational Health conducted ambient-air sampling and screening health-risk assessments of burn pit exposures at JBB twice in 2007 and once in 2009.
- Assessments designed to detect potentially harmful inhalation exposures of personnel at JBB to chemicals expected to be released by the burn pit.
- CHPPM reports indicated risk of acute health effects of all chemicals detected, except coarse PM, was low and that long-term health risks were “acceptable” (noncancer endpoints = hazard index of less than 1.0; cancer endpoints = risk ranging from 1 in 10,000 to 1 in 1,000,000 or lower), although some of the hazard indices were greater than 1.0.

CHPPM Air Monitoring Data

- Many local and regional sources of pollution
- Collected at 5 sampling sites on base (sites close together were treated as one site):
 - Mortar pit (considered to be upwind and background)
 - Guard Tower and Transportation Field (downwind; closer to pit)
 - H-6 Housing and Contingency Aeromedical Staging Facility (downwind, further from pit)
- Samples collected
 - Jan-Apr 2007 100-200 tons/day burned at height of pit use
 - Oct-Nov 2007, amount burned ½ that of spring; 2 incinerators working
 - May-June 2009, 10 tons/day waste burned, 3 incinerators in use
- Polychlorinated dibenzo-*p*-dioxins and dibenzo-*p*-furans (PCDDs/Fs), polyaromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs), and PM were measured
- No monitoring for U.S. criteria air pollutants, i.e., ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide

JBB Air Monitoring Conclusions

- Background concentrations of PM were high, on average higher than U.S. air-pollution standards and were most likely derived from local sources (e.g., traffic and jet emissions), and regional sources (e.g., long-range anthropogenic emissions and dust storms). Burn pit emissions may have contributed a small amount of PM.
- PCDDs/Fs were detected at low concentrations in nearly all samples; burn pit was probably the major source of these chemicals. The toxic equivalents of the concentrations were higher than those in the U.S. 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 U.S.; major sources are regional background, ground transportation, stationary power generation, and the JBB airport.

Potential Health Effects

- Assessed 47 pollutants detected in at least 5% of the air-monitoring samples, plus 4 others thought likely to be in burn pits emissions although not detected, 51 total
- VOCs, PAHs, PCDDs/Fs, and PM all associated with long-term health effects
- However, all health effects studied for individual chemicals, often in animal experiments or under exposure conditions very different from exposure to burn pit emissions.

Potential Health Effects

- Health effects associated with 5 or more chemicals detected at JBB include:
 - Neurologic effects and reduced CNS function.
 - Liver toxicity and reduced liver function.
 - Cancer (stomach, respiratory, and skin cancer; leukemia; and others).
 - Respiratory toxicity and morbidity.
 - Kidney toxicity and reduced kidney function.
 - Blood effects (anemia and changes in various cell types).
 - Cardiovascular toxicity and morbidity.
 - Reproductive and developmental toxicity.
- Exposure assessment on a chemical-by-chemical basis does not address cumulative and multiple exposures to chemical mixtures

Health Effects in Surrogate Populations

- DoD conducted preliminary health risk assessments of active-duty personnel exposed to burn pit emissions at JBB compared with other military populations with no such exposure
 - No increased risk for lupus, rheumatoid arthritis, respiratory diseases in exposed personnel
 - Studies are not of sufficient duration to see long-term effects
- Other populations that might have exposures to combustion products that are similar to burn pit emissions were considered:
 - Firefighters
 - Municipal incinerator workers
 - People living in communities near incinerators
 - Veterans of 1990-1991 Gulf War exposed to oil-well fires
- Committee recognized that these exposure were different from personnel at JBB but best surrogates available.

Health Effects in Surrogate Populations

Conclusions

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 surrogate populations studied.

However, there is limited/suggestive evidence of an association between exposure to combustion products and reduced pulmonary function in these populations.

Synthesis

The committee based its conclusions regarding the long-term health consequences of exposure to emissions from burn pits in Iraq and Afghanistan on three sources of information:

- Air-monitoring data collected at JBB in 2007 and 2009
- Health-effects information on 47 chemicals detected in more than 5% of the air-monitoring samples at JBB, plus 4 other chemicals
- Health effects information on populations considered to be surrogates of military personnel exposed to combustion products from burn pits

Committee's Conclusions

- Air-monitoring data suggest that pollutants of greatest concern at JBB is mixture of chemicals from regional background and local sources—other than the burn pit—that contribute to high PM
- Unable to say whether long-term health effects are likely to result from exposure to emissions from the burn pit at JBB due to lack of exposure information; however...
- 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 and/or susceptible populations, mainly because of high ambient concentrations of PM. In this case, increased risk of cardiovascular and respiratory problems.

Committee's Conclusions

- 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

Study Limitations

- Lack of information on content of burn pit waste stream prevented modeling efforts for source apportionment.
- Air monitoring did not appear to be conducted during heavy smoke events reported by deployed personnel.
- Lack of monitoring information on other possible sources of pollution also made it difficult to assess impact of burn pit on ambient air pollution.
- Air sampling and analysis of those samples was not always appropriate for assessing ambient air pollution
- Lack of information on proximity of personnel to burn pit and number of personnel who may have worked in pit prevented better exposure assessment
- Uncertainty of nature of exposures for surrogate populations makes comparisons with JBB personnel problematic

Future Epidemiologic Study of Veterans Exposed to Burn Pit Emissions

Feasibility and Design Issues:

- Need for prospective study with observations beginning at first deployment and with sufficient follow-up to identify health outcomes with long latency
- Conduct pilot study to determine sample size for sufficient power to study specific health outcomes
- Better air monitoring and sample analysis to assess exposure (possible use of biomonitoring)

Epidemiologic Study : Tiered Approach

•**Tier 1:** *Did proximity to burn pit operations at JBB increase the risk of adverse health outcomes?*

- Compare health outcomes in JBB personnel with high exposure to burn pit emissions (e.g., lived/worked near/in pit) with JBB personnel with low exposure (worked/lived at a distance or upwind of the pit).

•**Tier 2:** *Did installation of incinerators at JBB reduce the incidence of disease or intermediate health outcomes?*

- Compare health outcomes in those deployed to JBB prior to incinerator operations with those deployed to JBB since burn pit operations ceased.

•**Tier 3:** *Was deployment at JBB during full burn-pit operation associated with a higher risk of adverse health outcomes than deployment elsewhere in Iraq or Afghanistan or with no deployment?*

- Compare health effects of those deployed at JBB during burn pit operations with military personnel deployed to Iraq/Afghanistan locations without burn pits or with military personnel not deployed to the theater.