Soldiers and Oil Well Smoke

Respiratory Connection Remains Hazy

In February 1991, Iraqi soldiers ignited some 600 oil wells in the deserts of Kuwait as they retreated northward in the last days of the Gulf War. In the wake of this environmental disaster, thousands of U.S. troops were exposed to plumes of thick, black smoke. In subsequent years, many veterans have reported a variety of symptoms that they, certain media reports, and some researchers attribute to wartime exposures. But to date, the evidence tying deployment-related health effects to these specific exposures remains sketchy. In this month's issue, investigators led by Jeffrey L. Lange of the University of Iowa College of Public Health report that respiratory symptoms among Gulf War veterans may not be related to their exposure to oil-smoke during the war [***EHP* 110:1141–1146**].

These conclusions are based in part on a novel approach developed by the researchers to model the historical exposure. Specifically, a geographic information system was used to integrate troop movements in the Gulf War theater with air pollution monitoring data gathered while the fires were burning. As a point of comparison, the researchers also used self-reported exposure information based on veterans' responses to questions about where they were in relation to the fires and how long they were exposed. These responses were obtained through telephone interviews conducted five years after the war during a previous study by members of the same research team.

Included in the cohort were 1,560 Iowa veterans who served in the Gulf War between 2 August 1990 and 31 July 1991. The team evaluated symptoms of asthma and bronchitis, and two problems thought to be irrelevant to the oil-smoke exposure: symptoms of major depression and physical injuries occurring within three months of the phone interview.

Surprisingly, the incidence of asthma and bronchitis symptoms was found to increase significantly with the self-reported exposures but did not increase with the modeled exposures. Notably, the authors support the modeled findings and a conclusion of no obvious association between the exposure and health effects. This is because the same correlations—increase with self-reported exposures but not modeled exposures—held true for the control symptoms of major depression and physical injuries. This suggests that associations between self-reported exposure and health effects may be due to recall bias among veterans, meaning that their recollections of both exposure and symptoms in general may be exaggerated. In support of this hypothesis, soldiers who judged themselves less prepared, mentally and physically, for the rigors of military service were more likely to report both respiratory and control symptoms as well as more days of exposure to oil-fire smoke. However, exposure modeling showed no difference in exposure between those with high and low levels of military preparedness.

The authors state that the modeled scenarios were developed as a novel way to independently verify self-reported exposures. Measurement errors in the modeled data were independently verified where possible. But in the end, the data taken as a whole do not support an association between oil-smoke exposure and subsequent respiratory problems in Gulf War veterans. **–Charles W. Schmidt**

A questionable link? The smoke from oil wells burned in the last days of the Gulf War has been suspected of contributing to veterans' later respiratory health problems. However, new research suggests otherwise.

Sign of trouble. Brown spots on the hands are among the first signs of arsenic poisoning.

The Slow Poisoning of Bangladesh

Metals in Drinking Water

The quest for safe drinking water in the People's Republic of Bangladesh currently seems to be a lose–lose endeavor. The people of Bangladesh used to get almost all their drinking water from surface sources, which were often contaminated with bacteria causing such life-threatening health effects as diarrheal disease, cholera, and typhoid. To reduce the incidence of these diseases, millions of tubewells have been installed in Bangladesh since 1971, and this transition to groundwater has significantly reduced deaths from waterborne pathogens. However, new evidence from an international volunteer team of researchers led by Bibudhendra Sarkar of Toronto's Hospital for Sick Children suggests that illness from poisoning with arsenic and other toxic elements in groundwater now affects large areas of Bangladesh [***EHP* 110:1147–1153**]. In addition to studying the extent of arsenic poisoning in Bangladesh, this exposure assessment studies for the first time metals that may affect arsenic toxicity.

Currently, 97% of Bangladesh's 127 million people drink tubewell water. Vast areas of the country contain groundwater contaminated with naturally occurring arsenic in concentrations above the World Health Organization (WHO) drinking water guideline of 0.01 mg/L. According to a survey by the U.S. Agency for International Development, 45% of Bangladesh's groundwater shows arsenic concentrations in excess of the country's own drinking water standard of 0.5 mg/L.

Symptoms of toxic metal poisoning include serious skin diseases such as melanosis, leukomelanosis, keratosis, nonpitting edema, gangrene, and skin cancer. The first case of poisoning attributed to arsenic-contaminated groundwater was diagnosed in 1993. From 1993 to 1999, a total of 2,953 cases of chronic arsenic poisoning were diagnosed in Bangladesh, but the actual number of cases may be in the tens or even hundreds of thousands.

Sarkar and colleagues collected groundwater samples from 112 tubewells throughout Bangladesh from 20 December 1998 to 18 January 1999. One sample was taken from each well and analyzed for arsenic plus 29 other elements or ions. The team found that arsenic is not the only geochemical contaminant occurring at levels exceeding WHO guidelines. About 50% of the samples had manganese concentrations above the WHO guideline, and 3% had lead above the WHO guideline. In some

Top to bottom: WHO; U.S. Department of Defense

small areas, concentrations of barium, boron, chromium, lead, molybdenum, nickel, and uranium were found to exceed WHO guidelines. Because of the high percentage of Bangladeshis that drink water from tubewells, these data suggest that tens of millions of people are ingesting unsafe levels of toxic elements.

In assessing the symptoms of poisoning, Sarkar and colleagues came to suspect that other elements play a role in arsenic poisoning. One example is antimony, which intensifies arsenic poisoning and was detected in 98% of the water samples. Moreover, none of the samples contained detectable levels of selenium or zinc, both of which inhibit chronic arsenic poisoning. Bangladeshis may therefore show deficiencies in these elements that would magnify arsenic toxicity.

However, arsenic in tubewell water poses the most significant health risk, say the researchers. This risk could be mitigated through systematic groundwater monitoring, drilling deeper tubewells, and appropriate treatment options. Abatement efforts should not be limited to arsenic, though; health risks from other toxicants such as chromium, lead, manganese, and nickel in Bangladesh's drinking water also must be addressed. Strategies to supply the country with safe drinking water need to be studied, developed, and quickly implemented. **–Julian Josephson**

Cooking Catastrophe

Chronic Exposure to Burning Biomass

With about half of the world's population relying on biomass fuels (wood, agricultural residues, and charcoal) as the primary source of household energy, research attention is increasingly focusing on this cause of indoor air pollution. In India, 5–6% of the nation's burden of disease has been estimated to be attributable to biomass combustion. Although biomass burning is clearly a major health risk factor, few quantitative exposure assessments have been performed in India to help clarify the exposure–response relationship. Now, a team of Indian researchers led by Kalpana Balakrishnan from the Sri Ramachandra Medical College and Research Institute (Deemed University) have assessed and quantified exposures to respirable combustion products in 436 rural households in the southern Indian state of Tamil Nadu [***EHP* 110:1069–1075**].

Exposure to the respirable particles and gases generated by the combustion of biomass fuels has been linked in several studies to adverse health effects such as chronic bronchitis and acute respiratory infections in children. Although a few studies similar to this one have been conducted previously in northern India, none have been done in the south, where the climate and culture are very different, resulting in patterns and concentrations of exposure at variance with data obtained in the north.

Biomass fuels are seldom used for heating in the warmer southern regions, but are widely used for both indoor and outdoor cooking. About 90% of the households studied used only biomass fuels, and even among the households that used comparatively clean fuels such as kerosene, 95% used biomass fuels to cook at least one meal a day. In addition, say the authors, women's movements are less restricted in the south—unlike in northern India, women in the south do not cover their faces and usually may move outside the house even in the presence of men, factors that could substantially reduce exposures.

To assess a variety of potential exposures to particulates generated by biomass combustion, the researchers sampled both indoor and outdoor air during cooking and noncooking times, and had women who were cooking wear a personal air sampler during meal preparation. In addition, all adult household members (women cooks, women assisting with cooking, women not involved with cooking, men who stayed at home, and men who worked outside the home) kept time–activity records. The team also gathered information about other exposure covariants such as fuel type, whether the kitchen was inside (with or without a partition) or outside (attached or nonattached), number of meals cooked, cooking duration, and time spent in or near the kitchen during cooking.

The investigators used the personal air sampler and time–activity record data to determine exposures for all household adults over a 24-hour period. They found that fuel type, type and location of kitchen, and time spent near the kitchen while cooking were the most important determinants of exposure, with the women cooks, as would be expected, encountering the highest average exposures. Their data also showed that living area concentrations were often greater than kitchen concentrations in households with partitionless kitchens, presumably because the increasing distance from the stove allowed for greater dispersal of particulates. This puts the elderly and young children, who are likely to be indoors during cooking times, at high risk of adverse effects from exposure.

The authors suggest that this baseline exposure information will help lay the framework for the creation of a regional exposure database, which would be useful in future studies of the exposure–response relationship in indoor air pollution in India and other developing countries. **–Ernie Hood**

Kalpana Balakrishnan

Trouble in the kitchen. Personal air sampler and time–activity data confirm that women who cook by burning biomass have the highest exposure to toxic pollutants.