OCCUPATIONAL HEALTH

Study to Examine Health Effects in Deepwater Horizon Oil Spill Cleanup Workers

In the wake of the BP Deepwater Horizon disaster in the Gulf of Mexico, the National Institute of Environmental Health Sciences (NIEHS) has launched the largest study ever on the health consequences of oil spill cleanup.1 Led by Dale Sandler, who heads the NIEHS’s intramural Epidemiology Branch, the GuLF STUDY (Gulf Long-term Follow-up study) aims to enroll 55,000 workers and volunteers involved in the BP oil spill response, including 5,000 controls.2

National Institutes of Health director Francis Collins pledged $10 million for the study on 15 June 2010.3 Sandler says the full cohort should be assembled within 18–24 months. “We’ve got funding for five years, but we designed the study so it can go up to twenty years,” she says, “If we want to assess links between oil spill response and rare cancers, we’ll have to go that far.”

Nalini Sathiakumar, an environmental and occupational epidemiologist at the University of Alabama at Birmingham School of Public Health, says the GuLF STUDY’s size and prospective design distinguish it from earlier health investigations of oil spill responses. “Previous studies primarily examined short-term health effects and were cross-sectional, meaning they looked at exposure outcomes at just one time point,” she says, “What you really want to do is a longitudinal assessment of exposure–outcome relationships, and that’s what this study does.”

According to Sandler, the GuLF STUDY will focus especially on respiratory, neurological, and hematological outcomes linked in the toxicologic literature to oil constituents. And taking a cue from other environmental disasters such as the nuclear accident at Three Mile Island and the World Trade Center attacks, she says, many people reported mental stress,4,5 the GuLF STUDY will also investigate psychological outcomes in relation to cleanup and living in the Gulf region.

Exposure to volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and dispersants will be estimated based partly on environmental monitoring data gathered by agencies and organizations during the response. Sandler says. Those data will be used to construct job-exposure matrices, which will also be informed by self-reported answers to a telephone questionnaire the NIEHS began administering in late March. The questionnaire requests information about where individuals worked during the cleanup, how long they worked, what they did, and whether they used personal protective equipment, in addition to background information about family health history, lifestyle, diet, mental health status, and prior employment history.

In addition, investigators will collect samples of blood, hair, toenail, urine, and other biospecimens from about half the participants to search for biomarkers showing some evidence of interaction with or influence on a biological process. DNA adducts, chromosome damage, and altered ability to repair DNA are examples of the sorts of biomarkers being considered.

Ideally, the study will allow scientists to link job categories and estimated exposures during the cleanup to a range of frank and subtle health effects over time. Sandler says. The NIEHS will publicize results in periodic summary reports, “and anyone who wants access to the data will be able to submit a request,” Sandler says. “Scientists will have to honor confidentiality—it’s important to respect the privacy of data given to us in confidence.”

Bill Farland, senior vice president for research at Colorado State University in Fort Collins and an invited speaker at a June 2010 Institute of Medicine workshop titled “Assessing the Human Health Effects of the Gulf of Mexico Oil Spill,” describes the study as well designed, particularly because it investigates both physiological and mental health outcomes. “What we’re most concerned about are the VOC and PAH exposures,” he says. “This is what people who were exposed to the oil slick itself would have come in contact with.”

Charles W. Schmidt, MS, an award-winning science writer from Portland, ME, has written for Discover Magazine, Science, and Nature Medicine.

REFERENCES AND NOTES
1. GuLF STUDY [website]. Research Triangle Park, NC: National Institute of Environmental Health Sciences, National Institutes of Health (2011). Available: http://tinyurl.com/5cdylqj [accessed 6 Apr 2011].
2. Controls include 1) people who completed safety training in anticipation of performing cleanup work but did not actually perform any cleanup-related tasks and 2) community residents or friends or relatives identified by workers in the cohort.
3. NIEHS, NIH to Launch Gulf Oil Spill Health Study; BP Will Provide Additional Funds for Research [press release]. Research Triangle Park, NC: National Institute of Environmental Health Sciences, National Institutes of Health (7 Sept 2010). Available: http://tinyurl.com/stm2a7h [accessed 19 Apr 2011].
4. Dew MA, Bromet EJ. Predictors of temporal patterns of psychiatric distress during 10 years following the nuclear accident at Three Mile Island. Soc Psychiatry Psychiatr Epidemiol 28(2):49–55 (1993); PMID: 8311662.
5. Bills CB, et al. Mental health of workers and volunteers responding to events of 9/11: review of the literature. Mount Sinai J Med 75(2):115–127 (2008); doi: 10.1002/mmj.20026.
Traffic Trigger

Do traffic-related stress and air pollution trigger more heart attacks than cocaine, caffeine, anger, or sex? New findings by a group of European researchers published in the 26 February 2011 issue of The Lancet suggests they may.¹

When studying heart attack, or myocardial infarction, scientists look at two things: who has heart attacks and when. Many risk factors contributing to heart attacks are well known—hardening of the arteries (atherosclerosis), the chief factor underlying myocardial infarction, is strongly linked to cholesterol, diabetes, blood pressure, smoking, and family history of the condition. Within an at-risk individual, certain trigger events may set off a heart attack. Most research on heart attack triggers has focused on risk at an individual level, but this study took a novel approach by assessing the populationwide impacts of 13 different triggers.

The authors used a comparative risk assessment analysis using 36 previously published studies of nonfatal heart attack to determine the relative risk of each of 13 suspected triggers to both individual and overall public health. “One of the contributions of our paper, besides ranking the trigger factors, is that this is really an exercise in demonstrating the discrepancies between individual and population-based risks,” says lead author Tim Nawrot, an associate professor of environmental epidemiology at Hasselt University in Belgium.

The authors report that although certain triggers—including particulate air pollution and participation in traffic—were associated with relatively low risk at an individual level, on a population level they were associated with more total heart attacks. The triggers associated with heart attack at the individual level, ranked from highest to lowest risk, were cocaine use, a heavy meal, marijuana use, negative emotions, physical exertion, positive emotions, sexual activity/anger/alcohol (tied), traffic exposure, respiratory infection, coffee consumption, and air pollution. But when the authors looked at the population attributable fraction (PAF)—or the proportion of heart attacks preceded by each trigger—the ranking changed. Traffic exposure (potentially including both air pollutant and stress exposures) was associated with more heart attacks than any other single factor (see table).

Population-level rankings are determined by the prevalence of exposure, as well as the level of risk associated with the exposure. “Many more people are exposed to increased levels of air pollutants more frequently than to many other triggering risk factors, so from a population standpoint, air pollution may be more important,” says Joel Kaufman, a professor of environmental and occupational medicine at the University of Washington. He points out that air pollution exposure is not something people can always make a choice about, unlike smoking or cocaine use. Other known triggers such as temperature extremes² and secondhand tobacco smoke³ were not addressed in the study, nor were interactions among triggers.

Kaufman said he might quibble with some numbers in the paper. “It’s not clear that [the authors] used consistent or realistic methods to determine the prevalence of exposure for air pollution versus other things,” he says. “For air pollution they’ve been rather generous by listing it at a hundred percent while some other factors were given what seem to be surprisingly low or high assignments of exposure prevalence that don’t reflect the general population at risk for heart attacks.”²

But he says this does not change the study’s message.

Epidemiology professor Charles Poole of the University of North Carolina at Chapel Hill has concerns over using PAFs in studies of public health impacts. Essentially, PAFs assume it is possible to completely eliminate a trigger, which is highly unlikely for things like emotions or sexual activity. “[PAFs] are vast overstatements of the amount by which heart attack incidence could be reduced,” Poole says. “It’s proposed as a way of guiding public health measures and policy decisions [that is] grossly unrealistic.” On the other hand, Poole liked that Nawrot et al. used realistic reductions in particulate air pollution of 10 and 30 µg/m³ rather than complete elimination. He says that, although triggers are worthy of study, from a public health perspective it is more important to focus on reducing the number of people who are one trigger event away from a heart attack.

An expert panel of the American Heart Association issued a statement⁴ in 2010 (updating their 2004 statement⁵) indicating that a substantial amount of evidence has accumulated suggesting air pollution triggers heart attacks; what’s more, they said plausible mechanisms exist for how air pollution may contribute to coronary atherosclerosis. In other words, exposure to air pollution also puts more people at risk for developing heart disease. In that sense, air pollution is a public health concern that both scientists and practitioners are starting to take seriously.
Can Transgenic Plants Root Out Pollutants?

A team of researchers at Colorado State University in Fort Collins and Duke University in Durham, North Carolina, have created transgenic plants that turn from green to white when exposed to the explosive 2,4,6-trinitrotoluene (TNT). Ultimately, the researchers hope, several simple and affordable plants will be developed that can quickly sense a variety of biological and chemical agents.

The research team combined genes from bacteria and plants to construct a modular “de-greening” gene circuit that breaks down chlorophyll, the green pigment in plants, while simultaneously preventing chlorophyll biosynthesis. The gene circuit contains a customized receptor for a specific hazardous agent—in this case, TNT. When the receptor binds its target, it triggers the de-greening reaction.

“The color conversion in the laboratory plants took 2 to 3 hours. Medford’s team is working to reduce the response time to minutes rather than hours. Just picomolar (ppt) or nanomolar (ppb) levels of TNT activated the de-greening process, suggesting the system is feasible for real-world applications.”

Dogs trained to sniff out explosives and drugs generally discern these agents at ppb or ppt concentrations.

The plant technology could be deployed “along travel routes to detect for improvised explosive devices or on training ranges to monitor for TNT contamination in soil or runoff,” says Linda Chrisey, biotechnology program manager at the Office of Naval Research in Arlington, Virginia. According to the Agency for Toxic Substances and Disease Registry, TNT contamination is found on at least 20 National Priorities List sites identified by the U.S. Environmental Protection Agency. People can be exposed to TNT through eating, drinking, touching, or inhaling contaminated soil, water, food, or air, with potential health effects including anemia, abnormal liver function, skin irritation, and cataracts.

Transgenic sentinel plants should not face disposal concerns, because they do not become chemically saturated, according to Medford. “This is not phytoremediation; we’re talking about exceeding low levels of contaminants,” she says. Moreover, she says, “We don’t intend to put this technology into plants that people eat.”

“Can transgenic plants root out pollutants? This is a revolutionary approach to working with plants as environmental sentinels that looks to have broad application,” says Bill Farland, senior vice president for research at Colorado State University. For instance, plants may someday sniff out air or water pollutants released from industrial sources such as chemical manufacturing plants. Other potential applications, Chrisey notes, include the detection of herbicides on crops, pathogens in municipal water supplies, or explosives in airports.

“We still have to explore all the possibilities of chemicals that could be sensed by plants,” Farland says. The key lies in designing a receptor for a pollutant of choice and engineering it into the plant de-greening circuit. Medford’s team also is designing plants with multiple receptors to detect more than one pollutant.

OSHA Issues Alert on Formaldehyde in Hair-Straightening Products

As a result of concerns from salon employees, federal and state officials are investigating worker exposures to formaldehyde during use of hair-straightening products, some of which contain the chemical without listing it on the label. One investigation documented air levels of formaldehyde in excess of OSHA limits for salons even though the product used was labeled “formaldehyde-free.” In April 2011 OSHA issued a hazard alert to warn salon owners and workers about the potential health effects of formaldehyde, ways to determine if products contain the chemical, and steps to reduce exposure. Formaldehyde, a known human carcinogen, can also irritate the nose and eyes and cause adverse allergic and neurologic effects.

Global Study Finds cVMS Widely Distributed in Air

cVMS, or cyclic volatile methyl siloxanes, are high-production-volume chemicals used in personal care products to make them feel silky and to help them dry quickly. A new study of cVMS in ambient air found...
in France reported that they had genetically engineered tadpoles to detect zinc in water with a portable, flow-through system. Like Medford’s plants, the transgenic tadpoles carry a receptor for a selected pollutant that triggers fluorescence in about an hour. Also, tadpoles are being designed to detect more than one environmental pollutant—potentially to include heavy metals, organochlorine pesticides, bisphenol A, polychlorinated biphenyls, and dioxins—and to generate several fluorescent colors. Plants and tadpoles provide relatively cheap monitoring systems, Johnson says, and they give results rapidly onsite, compared with carrying samples back to a laboratory for expensive analysis such as mass spectrometry. Plus, he says, living systems, particularly animal-based ones, reflect physiologic effects of environmental pollutants similar to those that occur in humans.

“The detection of contaminants and pollutants in air and water is a rapidly expanding area, and new developments will stay fruitful for a long time,” Johnson says.

Carol Potera, based in Montana, has written for EHP since 1996. She also writes for Microbe, Genetic Engineering News, and the American Journal of Nursing.

REFERENCES AND NOTES

1. Antunes MS, et al. Programmable ligand detection system in plants through a synthetic signal transduction pathway. PLoS ONE 6(1):e16292 (2011); doi:10.1371/journal.pone.0016292.

2. Oxley IC, Waggoner LP. Detection of explosives by dogs. In: Marshall M, Oxley JC, eds. Aspects of Explosives Detection. Amsterdam, The Netherlands: Elsevier, pp 27–40 (2009); doi:10.1016/B978-0-12-374533-0.00003-0.

3. Johnson JM. Canine Detection Capabilities: Operational Implications of Recent R & D Findings. Auburn, AL: Institute for Biological Detection Systems, Auburn University (1999). Available: http://tinyurl.com/3povs7s [accessed 19 Apr 2011].

4. ATSDR. ToxFAQs™ for 2,4,6-Trinitrotoluene (TNT), CAS#518-96-7, September 1996. Atlanta, GA: Agency for Toxic Substances & Disease Registry, U.S. Centers for Disease Control and Prevention (updated 3 Mar 2011). Available: http://tinyurl.com/3nkgbzn [accessed 19 Apr 2011].

5. Fini IB, et al. An innovative continuous flow system for monitoring heavy metal pollution in water using transgenic Xenopus laevis tadpoles. Environ Sci Technol 43(23):8895–8900 (2009); doi:10.1021/es9008954.

6. After use the tadpoles are euthanized, then disposed of under the same guidelines as laboratory cell culture media. They are contained in a closed tank and are not released into the wild.

EPA Warns of Illegal Pesticide Sales Online

In April 2011 the U.S. EPA announced it had warned almost 3,000 customers across the country about Fast Ant Bait products they had purchased online. The products contain mirex, a pesticide banned since 1978 because of its adverse liver, skin, reproductive, and neurologic effects. When EPA officials discovered the products were being sold online, they ordered the online payment company to cease processing orders for the Chinese-made and -distributed products. The EPA notified U.S. customers about the health risks posed by the products and how to properly clean up and dispose of them. Canada’s Pest Management Regulatory Agency has notified customers in that country as well.

REFERENCES

1. NTP Speaks About Aloe Vera [website]. Research Triangle Park, National Toxicology Program, National Institute of Environmental Health Sciences, National Institutes of Health, U.S. Department of Health and Human Services (updated 3 Mar 2011). Available: http://tinyurl.com/68pyp4d [accessed 19 Apr 2011].

2. OSHA. Formaldehyde. Hazard Alert: Hair Smoothing Products That Could Release Formaldehyde [website]. Washington, DC: Occupational Safety and Health Administration, U.S. Department of Labor (2011). Available: http://tinyurl.com/3mkghzn [accessed 19 Apr 2011].

3. ATSDR. ToxFAQs™ for Formaldehyde, CAS# 50-00-0, September 2008. Atlanta, GA: Agency for Toxic Substances & Disease Registry, U.S. Centers for Disease Control and Prevention (updated 3 Mar 2011). Available: http://tinyurl.com/4yembxu [accessed 19 Apr 2011].

4. Genuaid S, et al. Global distribution of linear and cyclic volatile methyl oxazoles in air. Environ Sci Technol 45(8):3349–3354 (2011); doi:10.1021/es1035313.

5. EPA. EPA Warns Online Shoppers about Illegal, Harmful Pesticide Sales [press release]. Washington, DC: U.S. Environmental Protection Agency (21 Mar 2011). Available: http://tinyurl.com/3mwb86b [accessed 19 Apr 2011].

6. ToxFAQs™ for Mirex and Chlordecone, CAS# Mirex 2385-85-5; Chlordecone 143-50-0, September 1996. Atlanta, GA: Agency for Toxic Substances & Disease Registry, U.S. Centers for Disease Control and Prevention (updated 3 Mar 2011). Available: http://tinyurl.com/3pso5v7 [accessed 19 Apr 2011].

“Living organisms have advantages as sentinels of pollution,” says Paul Johnson, a professor of physics and astronomy at the University of Wyoming in Laramie. In 2009 he and colleagues analyzed the compounds clustered in varying distributions at each of 20 sites around the world, including 5 Arctic sites. The D5 and D6 species of cvMA concentrated in the urban sites studied, whereas the D3 and D4 species were especially elevated along the U.S. West Coast. D5 and D6 are the cVMS used most commonly in personal care products, while D3 and D4 are thought to be associated with industries that produce silicone polymers. Currently there are no restrictions on any use of cVMS, but regulators in a number of countries are paying more attention to these compounds because of evidence they may be persistent, bioaccumulative, and toxic.

Epifluorescence images of different portions of transgenic Arabidopsis roots shown before and after addition of the TNT ligand. Far right panels show DAPI nuclear staining. Arrowheads indicate nuclei. Scale bar = 25 µm.