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# Get a Load of the Mono-2-Ethylhexyl-Phthalate In That Guy

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Special to The Washington Post  
Tuesday, February 3, 2004; Page HE01

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You failed the blood test.

Locked in fat cells and circulating through your blood is a potentially toxic cocktail of thousands of industrial chemicals, some of which have been banned for more than a decade. They have names with pronunciations as frightful as the chemicals themselves: dichlorodiphenyltrichloroethane, gamma-hexachlorocyclohexane and mono-2-ethylhexyl-phthalate.

You can eat right and exercise, swear off cigarettes and bypass northern New Jersey by a good 100 miles on your way to New England. But you cannot avoid a daily dose of these substances that -- in a laboratory, fed to animals at high doses -- cause cancer and neurological problems. They may, or may not, have similar effects on people.

Such chemicals, byproducts of the industrial age, are everywhere, in the soil, air and water. And now, through an increasingly common technique called biomonitoring, which measures pollutants in samples of human milk, blood and urine, these chemicals are being found in all of us at levels that some scientists call alarmingly high.

Are these chemicals the cause of the higher rates of breast cancer, Alzheimer's and autism seen in recent years? Scientists aren't sure. Some say that disease is not rampant, that we're just getting better at diagnosing it, and that we are living longer and healthier than ever. Others say that certain chemicals accumulate in the body and are bound to do us in eventually.

Biomonitoring is seen as a valuable tool to assess the danger of pollutants. Environmentalists in California, and other groups across the nation, are thinking about statewide biomonitoring programs, or "body burden" campaigns.

"We can't assume that just because a chemical is out there that it is getting into people," said James Pirkle, deputy director for science at the National Center for Environmental Health at the federal Centers for Disease Control and Prevention. "The advantage of biomonitoring is that it's not a measure of the concentration [of a pollutant] that *might* get inside you, but a measure of the dose that *does* get inside you."

Pirkle is the lead author of a 2003 CDC report on human exposure to environmental chemicals. This dose, measured through biomonitoring, he said, is the most health-relevant information available to scientists assessing the impact of pollutants on the human body in a real-world scenario.

### **The Food Chain Gang**

Because humans are at the top of the food chain, it is inevitable that we accumulate pollutants, however strict environmental laws may be. We eat the big fish that eat the little fish that eat the polluted plankton. We drink the milk and eat the butter of cows whose fat cells collect pesticides found in their feed. One leaf of one plant may contain only one "unit" of a toxin; but as one tiny animal consumes 100 leaves and one larger animal consumes 100 tiny animals, the number of toxin units at the top of the food chain can grow huge. Also, toxins know no borders, can come from any part of the world, and can be naturally occurring, like arsenic.

Switching to organic foods won't help, because chemicals such as dioxins and furans are ubiquitous, released into the air in industrial processes and even forest fires. These chemicals settle on organic crops and on the grass that the cattle raised for organic beef eat.

Vegetarians get a dose, too: Metals such as lead and cadmium are regularly found in organic vegetables, sometimes in higher concentrations than in conventional vegetables, depending on the metal content of the manure used as fertilizer.

Running off to the ends of the earth won't help, either. The Inuit peoples of Greenland and the Nunavut territory of Canada have some of the highest levels of polychlorinated biphenyl (PCB) contamination in the world, up to 50 times higher than people in southern Canada, according to ongoing research at several Canadian and Danish universities.

Banned in the United States in the 1970s, PCBs were used for decades in paints, adhesives, coolants and insulating materials. These chemicals leaked into waterways from landfills and were dumped outright into the oceans. They settled into sediment, were absorbed by plants and microorganisms, and slowly made their way into the fat of salmon, seals and whales, the primary food sources for the Inuit.

### **In the Blood Sample**

All told, we are exposed to tens of thousands of chemicals in our lifetime, Pirkle said, a number that has increased greatly since the 1940s. Fat-soluble chemicals tend to linger longer in our bodies than water-soluble ones. Metals can remain longer, too, because they can be absorbed into bone.

Biomonitoring complements laboratory animal studies, human studies on chronic diseases, and environmental assessments in understanding what levels get into our bodies and make us sick. We know much about the health effects of lead and mercury though this research feedback mechanism.

In the past, many pollutants were at levels in the body too low to be measured by the techniques of the day, even though they could be harmful at such low levels. Dioxin, a known carcinogen, may be dangerous at less than the part-per-trillion level but for years remained beyond detection. Lead and mercury, however, are dangerous at the part-per-million level and, even decades ago, were easy to spot in the blood. But technology has progressed to the point where complicated and trace pollutants can be distinguished and measured.

Also, metals have a characteristic spectrum, or fingerprint, which traditionally made them more readily identifiable in analysis compared to complicated molecules typical of pesticides. But technology has progressed to the point where these more complicated trace pollutants can be measured.

"The data are invaluable; we need this information," said Neal Langerman, chairman of the American Chemical Society's Division of Health and Safety.

The information doesn't imply that our bodies are in a toxic state of emergency, however.

"The issue that the public trips over all the time is the distinction between hazard and risk," Langerman said. A ladder can be a hazard, he said; standing on the top step poses a greater risk of severe injury than standing on the bottom step. The hazard is constant, but risk changes depending on use.

To extend the metaphor: Chemicals can be hazardous in their ability to cause cancer or neurological damage. Through biomonitoring, scientists may be able to ascertain the level, if any, at which these chemicals pose a serious health risk.

### **The Milk Issue**

The trick is to learn more about what's in people's bodies without terrifying them.

"We need to understand what's happening, but how we report it back to people is a real challenge," said Jane Hoppin of the National Institute of Environmental Health Sciences in North Carolina's Research Triangle Park and a research member of the Agricultural Health Study, an ongoing study of more than 60,000 licensed pesticide applicators and their spouses in Iowa and North Carolina. (Her team has found, among many things, that wheezing is marginally associated with several pesticides but becomes more likely with prolonged exposure.)

So, how does one inform a nursing mother that her milk contains dioxin? Scientists often refer to dioxin as the most toxic human-made chemical in existence. Dioxin is a fat-soluble chemical, which means it settles in the fat cells of the breast and in the milk of lactating women.

Dioxin undoubtedly passes to a suckling infant, who receives a dose six times higher than that received by a baby who is bottle-fed formula, according to a 2002 study by the Environmental Protection Agency. Yet the benefits of breast-feeding over bottle-feeding for the infant include a boost to its immune system, higher IQ and lower risk of obesity and diabetes later in life. The risk associated with ingesting minute traces of dioxin in human milk is not known. Most health experts recommend that mothers breast-feed, since the known benefits exceed the known risks.

Human milk is an excellent medium to assess fat-soluble pollutants, which include many pesticides such as dieldrin, aldrin and endrin, all of which have been now banned in the United States. That's why scientists like to analyze it. But will the knowledge of what in mother's milk frighten a mother away from breast-feeding? The issue may come to a head in California, where state Sen. Deborah Ortiz is proposing a bill to create a breast milk monitoring program.

"After researching the issue, I've come out as a born-again breast-feeding advocate," said Gina Solomon, a senior scientist at Natural Resources Defense Council, who reviewed drafts of the California bill. Solomon walks a tightrope in strongly encouraging breast-feeding and strongly encouraging milk monitoring. But she said breast-feeding for most women is too good an opportunity to pass up.

### **A Part Per Billion of Prevention...**

Sweden has monitored human milk since 1972, and the detection of pollutants in the milk has not dissuaded Swedish mothers from breast-feeding, Solomon said. Instead, it has led to local bans on the use of certain chemicals that have been found in the milk, such as polybrominated diphenyl ether (PBDE), a common flame retardant shown to cause brain and nerve damage in lab animals. She's hoping that spirit can catch on in this country.

Studies have shown that women in the United States have 10 to 100 times more PBDEs in

breast tissue and milk as do Swedish women. This has led California to impose a ban on certain types of PBDEs, which will take effect in 2008.

It is not clear whether any of these pollutants in the human body is making anyone sick. The bans are largely preventive strategies.

The 2003 CDC report, which assessed human exposure to 116 chemicals, showed that for some chemicals things are looking positive. Lead levels in children were continuing to fall dramatically. Cotinine levels, a measure of secondhand tobacco smoke, had dropped by more than 50 percent in children and 75 percent in adults since the early 1990s (although children still had levels twice as high as nonsmoking adults). Dioxins, furans and certain PCBs were below detectable levels. Levels of the pesticide DDT, a particularly persistent pollutant in soil, were detectable even in young adults, despite the U.S. ban in 1973, but were still lower than they were in 1990.

The CDC's national study "is helpful, but it is not enough," said Solomon. "It's very important to get locally tailored results. That's why there is a move afoot to do biomonitoring here in California."

### **Are We Ready?**

Biomonitoring is a fact-finding tool, and both polluters and their ardent foes can gain or lose from the technique. Consider the case of Jackson County, Miss., in the mid-1990s, the site of widespread pesticide misuse over a two-year period that sickened hundreds when an outdoor bug killer was used illegally indoors. The EPA was prepared to evacuate entire towns at huge expense based on an initial environmental assessment. But biomonitoring allowed scientists to identify those residents most at risk (and uncover fraudulent claims of exposure). Only certain homes and businesses were targeted for decontamination. Elsewhere, biomonitoring has been used to confirm both overexposure and no exposure to a pollutant.

One concern, as biomonitoring spreads, is how the data will be used. The situation is analogous to privacy issues surrounding genetic research: Will insurance companies or employers discriminate against an individual with a high blood level of, say, a certain toxin known to cause cancer?

While there are no guarantees in place, Shelley Hearne, executive director of Trust for America's Health, a nonprofit public health organization advocating disease prevention, remains upbeat.

"We can take any issue and paint it into a worst-case scenario," Hearne said. "But I don't know a single case [of abuse] with lead," a metal associated with kidney disease and learning

disabilities. "This is the substance we know most about," she said, and people haven't been discriminated against over the amount of lead they are carrying. Hearne is former executive director of the Pew Environmental Health Commission, which has called for biomonitoring preparedness as a routine, modern-day public health response for those exposed to toxins from accidents and even bioterrorism, which many scientists say is a new and present threat.

The cost of biomonitoring programs also remains a top concern, particularly in cash-strapped states. Lead and metals are relatively inexpensive to monitor, as low as \$15 a test. A dioxin test can cost up to \$1,000 because it needs to be sensitive at the parts-per-trillion level, Solomon said. She hopes that the price will come down as the demand grows and techniques improve.

The CDC has allotted funding to 33 jurisdictions, including Virginia and the District of Columbia, to plan biomonitoring programs, an average of about \$300,000 each. Such funding could be used to prepare for emergencies, such as testing citizens and response workers in areas near large fires, industrial accidents, chemical spills and the like.

The California bill calling for breast milk monitoring was to be voted on in January but instead will be reintroduced this year "to fine-tune the bill's funding mechanism," according to a press release issued by the Breast Cancer Fund, a supporter of the legislation.

The bill, the first of its kind in the nation, could become effective as early as October 2004. •

*Christopher Wanjek is a regular contributor to the Health section. He last wrote about Nobel laureate Louis Ignarro's alliance with the supplement maker Herbalife.*

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