Study finds 56 suspect chemicals in average pregnant woman

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Each year, tens of thousands of chemicals are manufactured in or imported into the United States—more than 30,000 pounds of industrial chemicals for every American—yet experts know very little about which chemicals may enter people's bodies, or how these substances affect human health.

Now, scientists at UC San Francisco have found a way to screen people's blood for hundreds of chemicals at once, a method that will improve our ability to better assess chemical exposures in pregnant women, and to identify those exposures that may pose a health risk.

The scientists used a technique known as high-resolution mass spectrometry, which identifies chemicals by their molecular weight, to screen blood samples taken from pregnant women in San Francisco. This enabled them to scan a much larger number of chemicals at once than previous methods, which typically target about a dozen chemicals at a time. They scanned about 700 chemicals in the current study, finding, on average, 56 different suspect chemicals in the women's blood.

"As we suspected, more chemicals are present in pregnant women than previously identified, some of which may be hazardous to the developing fetus and to adults," said Tracey Woodruff, Ph.D., the senior author of the study, published in *Environmental Health Perspectives*. Woodruff is a professor in the Department of Obstetrics, Gynecology and Reproductive Sciences and the director of the Program on Reproductive Health and the Environment at UCSF "This also helps us prioritize chemicals for further study and prevention

UCSF's work contributes to the broader scientific initiative to measure the "exposome," or the totality of human environmental exposures from conception, so researchers and policy makers can determine which chemicals or combinations of chemicals are contributing to health problems.

"Screening for chemicals in a person is like finding needles in a haystack—there are thousands of chemicals in blood that come from different sources, so we need an efficient method to find those that matter," said Aolin Wang, Ph.D., a postdoctoral scholar in the PRHE in the UCSF Department of Obstetrics, Gynecology and Reproductive

Sciences, and the study's first author.

The new method screens for environmental organic acids (EOAs), compounds that have at least one ionizable proton and can be measured with the method, which detects the relative abundance of ions in a sample.

EOAs are widely used in pesticides and consumer products, and some, such as bisphenol-A, methylparaben, and triclosan, have chemical structures that are similar to hormones. They can cause endocrine disruption, which makes them particularly dangerous to pregnant women and their developing fetuses, since the chemicals may interfere with development.

People are exposed to these and other similar chemicals by using products, eating contaminated food, drinking contaminated water, or breathing contaminated air and dust.

The researchers first compiled a chemical database of 696 EOAs from a variety of publicly available sources, including the U.S. Environmental Protection Agency, the National Health and Nutrition Examination Survey (NHANES), the California Environmental Protection Agency, as well as private databases and data from the scientific literature.

They then analyzed maternal blood collected from pregnant women at two different hospitals: the Zuckerberg San Francisco General Hospital, which serves mostly low-income women of color who do not have health insurance; and UCSF Mission Bay Medical Center, which serves an economically and ethnically diverse population, including women of higher socioeconomic status.

"Our findings indicate numerous chemical exposures across the populations of pregnant women studied," said Rachel Morello-Frosh,

Ph.D., a professor of environmental science, policy and management at UC Berkeley and an author of the study. "Additionally, low-income women and women of color often face a disproportionate burden of social and environmental stressors that are linked to poor health outcomes."

After the initial screening of the women's blood, which revealed between 32 and 73 suspect chemicals per woman, the researchers used a more refined method to confirm the presence of a subset of these chemicals. They found six chemicals that had not been previously documented in pregnant women's blood, two of which—2,4-Dinitrophenol and pyrocatechol—may cause genetic defects, harm fertility or damage the fetus, or have carcinogenic effects.

Another chemical found in the study, 2,4-Di-tert-butylphenol, is a widely detected estrogenic compound. It is used in food-related plastic products, as well as plastic pipes and water bottles. In Europe, it has been found to migrate from water bottles and electric kettles made from chemical substitutes for bisphenol-A, an estrogen mimic that is being phased out.

"Our success with the current suspect screening approach indicates that this method can provide new insights regarding human exposures to potentially dangerous chemicals," said Woodruff. "Our results raise concerns about pregnant women's chemical exposures and can be used to inform evidence-based approaches to protect human health."

More information: The Toxic Matters brochure series from PRHE provides information on how to reduce chemical exposures: prhe.ucsf.edu/toxic-matters