

Exposure to benzene during pregnancy—a pilot study raises concerns

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Peace River Valley, in northeastern British Columbia, has become known in recent years as a place of hydraulic fracturing for natural gas - "fracking," as it's commonly called. What are the health impacts related to living near fracking sites where contaminants, including volatile organic compounds, are released? To try to answer that question, Élyse

Caron-Beaudoin, a postdoctoral researcher at the Université de Montréal Public Health Research Institute, studied a group of pregnant women who live in the area. Her results were published this week in *Environment International*.

High concentrations of muconic acid - a degradation product of benzene (a volatile, toxic and carcinogenic compound) - were detected in the urine of 29 [pregnant women](#) who participated in the [pilot study](#). Their median concentration of muconic acid was approximately 3.5 times higher in these women than in the general Canadian population.

In five of the 29 participants, the concentration of muconic acid surpassed the biological exposure index (BEI), a measure developed by the American Conference of Governmental Industrial Hygienists (ACGIH) to protect the [health](#) of people in the workplace. Caron-Beraudoin informed the five women of the results and communicated with their attending physicians. Guidelines of acceptable amounts of muconic acid in urine exist only for the workplace; there are none for the general population.

Not beyond a reasonable doubt

"Although the levels of muconic acid found in the participants' urine cannot prove beyond a reasonable doubt that they were exposed to high levels of benzene, these results do clearly demonstrate the importance of exploring human exposure to environmental contaminants in natural-gas (fracking) regions," said Marc-André Verner, the lead researcher on the study. Verner is a professor at Université de Montréal's School of Public Health and specializes in toxicological risk assessment.

"Muconic acid is also a degradation product of sorbic acid, which is often used as a preservative in the food industry," said Caron-Beaudoin. "However, we believe that diet alone is unlikely to explain the

concentrations we found in our participants. A more extensive study needs to be conducted with additional measures - to test the air and drinking water, for example - to confirm or refute the results of our pilot study."

Health hazards of benzene include birth defects

The health impacts of benzene are well-documented. "High exposure to benzene during pregnancy is associated with low birth weight, an increased risk of childhood leukemia and a greater incidence of [birth defects](#) such as spina bifida," said Caron-Beaudoin. "We were therefore very concerned when we discovered high levels of muconic acid in the urine of pregnant women."

It should be noted that there are multiple routes of exposure to benzene, including inhaling cigarette smoke, filling your car's gas tank, driving, and drinking benzene-contaminated water.

"Many reports have been written on the contamination of air and water by [volatile organic compounds](#) near natural-gas well sites," said Verner, who is also a researcher at the Public Health Research Institute.

"Northeastern British Columbia is a region that supports the use of [hydraulic fracturing](#) for natural gas. Despite the fact that many chemicals used or emitted by this industry are toxic to humans, no biological monitoring programs have been implemented in the region."

Indigenous people at the root of the study

Why did Quebec researchers lead a study exploring a public-health issue that mainly concerns people in Western Canada? Good question, Caron-Beaudoin replied. "At a conference, Professor Verner and I learned that certain indigenous communities, including the West Moberly First Nations, were concerned about the contaminants released by the many

natural-gas sites on their territory, and about how this was affecting people's health. They were looking for researchers to conduct a formal impact study. We expressed our interest, but were very surprised that this kind of study had never been carried out before."

Among the pilot study's 29 participants, 14 were indigenous. Results revealed that the median concentration of muconic acid in the urine of these 14 women was 2.3 times higher than in non-indigenous participants, and six times higher than in women from the general Canadian population. However, it is important to note that the different levels found in indigenous and non-indigenous participants was not statistically significant, possibly due to the small number of women involved. A study with a larger sample size would be necessary to verify if this difference is significant.

'Environmental racism' - a new concept

Nonetheless, these results raise the issue of "environmental racism," a concept that is being increasingly explored by public-health researchers. Environmental racism refers to intentional or unintentional discrimination in the development and implementation of environmental policy, which disproportionately favours the installation of facilities that are potentially harmful to human health in areas populated by cultural minorities and in low-income communities.

For example, a study done in 2016 in Texas (Johnston et al., 2016) revealed that wells used to dispose of wastewater coming from hydraulic fracturing sites were disproportionately permitted near communities with higher proportions of people of colour. "Environmental injustice is a major concern, particularly in indigenous communities where health inequalities are already an issue," said Verner.

A large-scale study now needed

What's next? Caron-Beaudoin and Verner have applied for funding from the Canadian Institutes of Health Research to conduct a major study of 100 pregnant women, using the same research methodology as in their pilot study. The study will involve doing an analysis not only of benzene biomarkers and other volatile organic compounds, but also of certain heavy metals in urine and hair samples. An environmental analysis of the participants' exposure to contaminants in the air and water will also be conducted. The data will then be modeled by Verner to estimate the fetal concentrations of these compounds, and thus more adequately measure the effects this type of exposure has on fetal development.

A second study led by Caron-Beaudoin will examine the medical data of approximately 6,000 babies born in the region over the past 10 years. "The goal is to assess the overall health of the babies (birth weight, pre-term births, head circumference and the prevalence of certain congenital birth defects) in relation to their proximity to natural-gas well sites and the number of active wells in their environment," the researcher said.

More information: Élyse Caron-Beaudoin et al, Gestational exposure to volatile organic compounds (VOCs) in Northeastern British Columbia, Canada: A pilot study, *Environment International* (2017).
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