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Featured Research Review:

Caron-Beaudoin, É. et al. (2022). Impact of volatile organic compounds (VOCs) on pregnant individuals living near shale gas development.

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Previous research has shown how shale gas development can impact local air quality through the release of volatile organic compounds (VOCs). Some VOCs have been linked to cancer, and others to a variety of health impacts including worsening respiratory system complaints like COPD and asthma (Goldstein et al., 2014). Exposure to VOCs during shale gas operations has also been associated with reduced birth weight, preterm birth, and neural tube defects (Chen et al., 2000).

In 2016, several partnering organizations based in Canada conducted a community-based pilot study examining the health impacts of exposure to benzene, toluene, and other trace elements in pregnant individuals. The results of this study launched a larger initiative examining the impact of VOCs in the Exposures in the Peace River Valley (EXPERIVA) study. This study was titled: Volatile organic compounds (VOCs) in indoor air and tap water samples in residences of pregnant women living in an area of unconventional natural gas operations: Findings from the EXPERIVA study.

In the EXPERIVA study, researchers measured the presence of VOCs in residential indoor air and tap water then compared their results to those of the general population to determine any associations between the amount of VOCs present and the proximity to shale gas development (Caron-Beaudoin et al., 2018). The researchers compared the results to those from the Canadian Health Measure Survey (CHMS), which was the third report on Human Biomonitoring of Environmental Chemicals in Canada (Health Canada, 2015).

From May to September of 2019, 85 pregnant individuals were selected to participate. Researchers collected water samples from their kitchen taps and deployed air sample collection tubes in the family room or bedroom for seven days. When looking at proximity to shale gas development, they examined the number of wells around each residence in three zones: 10 km (6.2 miles), 5 km (3.1 miles), and 2.5 km (1.5 miles). They then looked at the density of wells in ratio to proximity.

Some of the results of the study were the following:

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- Several VOCs known to be emitted during shale gas operations were found in the indoor air samples collected from households in high density areas of shale gas operations.
- 40 different VOCs were detected in more than 50% of the air samples collectedMore than half of the 40 detected VOCs had concentrations above the national medians from CHMS.
- A total of 44 VOCs were analyzed in the tap water samples from the participants.
    - Chloroform, bromodichloromethane, toluene, and total trihalomethanes specifically were detected in more than half of the samples.
    - Bromodichloromethane and total trihalomethanes were higher in study participants' water than the baseline measured in the households from CHMS.
- Levels of acetone and chloroform in the air, and total trihalomethanes in water, were higher for Indigenous populations and positively associated with proximity to shale gas operations. This supported the findings from their previous study of the disproportionate burden of environmental impacts on certain communities.
- Total trihalomethane concentrations in the water were positively associated with density and proximity of wells. (Trihalomethanes are a disinfectant by-product of chlorine reacting with other organics, and research has indicated such organics may be introduced to the water via the oil and gas waste stream.) (Landis et al., 2016).

This study indicates an increased presence of VOCs in water and air within households near shale gas development. Due to the previously documented health effects of VOCs on individuals, this study points towards the need for more research on the health impacts of shale gas development on pregnant individuals and environmental justice communities that are most burdened by these exposures.

To learn more about this study, explore these links:

- Caron-Beaudoin, É., et al. (2022). Volatile organic compounds (VOCs) in indoor air and tap water samples in residences of pregnant women living in an area of unconventional natural gas operations: Findings from the EXPERIVA study. *Science of The Total Environment*, *805*, 150242.I to https://doi.org/10.1016/j.scitotenv.2021.150242
- Caron-Beaudoin, É., Valter, N., Chevrier, J., Ayotte, P., Frohlich, K., Verner, M.-A., 2018. Gestational exposure to volatile organic compounds (VOCs) in Northeastern British Columbia, Canada: a pilot study. *Environ. Int.* 110, 131–138.
- Chen, D., Cho, S.-I., Chen, C., Wang, X., Damokosh, A.I., Ryan, L., Smith, T.J., Christiani, D.C., Xu, X., 2000. Exposure to benzene, occupational stress, and reduced birth weight. *Occup. Environ. Med.* 57, 661–667.

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- Goldstein, B.D., Brooks, B.W., Cohen, S.D., Gates, A.E., Honeycutt, M.E., Morris, J.B., Orme Zavaleta, J., Penning, T.M., Snawder, J., 2014. The role of toxicological science in meeting the challenges and opportunities of hydraulic fracturing. *Toxicol. Sci.* 139, 271-283. https://doi.org/10.1093/toxsci/kfu061
- Health Canada, 2015. Third Report on Human Biomonitoring of Environmental Chemicals in Canada: Results of the Canadian Health Measures Survey Cycle 3 (2012–2013)
- Landis, M. S., Kamal, A. S., Kovalcik, K. D., Croghan, C., Norris, G. A., Bergdale, A. (2016). The impact of commercially treated oil and gas produced water discharges on bromide concentrations and modeled brominated trihalomethane disinfection byproducts at two downstream municipal drinking water plants in the upper Allegheny River, Pennsylvania, USA. *Science of The Total Environment*, *542*, 505–520. https://doi.org/10.1016/j.scitotenv.2015.10.074

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