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Featured Research Review:

Clark, C. J., Johnson, N. P., Soriano Jr, M., et al. (2022). Shale Gas Development Exposure in Pennsylvania and Risk of Childhood Acute Lymphoblastic Leukemia

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Terms to know:

- [Acute Lymphoblastic Leukemia](#) (ALL)—the most common type of childhood cancer; it is cancer of the blood and bone marrow, which affects white blood cells.
- [Odds ratio](#)—the odds of an event happening in one group versus another. In this case, it is the odds of children living near at least one shale gas well developing ALL versus those not living near a shale gas well.
- [Primary window](#)—the window of time used in the study that included three months before conception up to one year prior to diagnosis of ALL.
- [Perinatal window](#)—the window of time used in the study that included three months before conception up to birth.
- [Upgradient](#)—a position up along a gradient from the starting position; this is sometimes referred to as upstream.

Shale gas development (SGD), sometimes called fracking or unconventional oil and gas development (UOGD), is a complex process that has the potential to release a variety of chemicals and radiological substances into both the air and water. A single well is known to produce between 1.7 and 14 million liters of wastewater over the first 5 to 10 years of production. Chemicals can seep into groundwater or surface water at nearly every stage of SGD, including during the drilling, extraction, transport, and storage processes as well as during the injection of wastewater into wells or the placement of solid waste into landfills. Of the hundreds of chemicals that have been reported to be present in SGD wastewater, some have been found to be correlated with leukemia. These chemicals include heavy metals, volatile organic compounds like benzene, radioactive materials such as radium 226, and polycyclic aromatic hydrocarbons. There has been limited research up to this point regarding exposure to SGD and the risk for childhood cancer.

A new study titled *Unconventional Oil and Gas Development Exposure and Risk of Childhood Acute Lymphoblastic Leukemia: A Case-Control Study in Pennsylvania, 2009–2017* (Clark, C. J., Johnson, N. P., Soriano Jr, M., et al., 2022) examined whether there was a correlation between exposure to SGD and cases of cancer, specifically acute lymphoblastic leukemia (ALL). The researchers obtained data through a registry in which they identified 405 children in Pennsylvania diagnosed with ALL between 2009 and 2017. They used regional data to understand proximity to SGD and employed a new water proximity metric to better identify potential pathways of exposure to the children. The researchers then looked at

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the exposure during two time periods: the primary window (three months before conception to one year before the diagnosis of ALL) and the perinatal window (three months before conception up to birth).

Researchers also used a novel metric referred to as ID_{ups} to understand water as a potential route of exposure. This metric is an inverse distance metric calculated on flow direction. It works off the idea that groundwater is going to flow downhill when in regions of hills and valleys, hence why the researchers looked for SGD wells upgradient of someone's home. Using this statistical method, the researchers found an indication that proximity to at least one upgradient SGD well led to increased odds of developing ALL.

Researchers found that children living in proximity to UOGD had up to 2 to 3 times the odds of developing ALL. More specifically, the study found:

- Children who were within 2 km (1.2 miles) of at least one SGD well during the primary window had 1.98 times the odds of developing ALL in comparison to those near no SGD wells.
- Children who were within 2 km (1.2 miles) of at least one SGD well during the perinatal window had 2.80 times the odds of developing ALL in comparison to those near no SGD wells.
- The odds ratio is considered statistically significant when researchers only factored in the birth year of the child. However, even when they accounted for other factors (such as race, socioeconomic status, etc.), the odds ratio was still considered statistically significant:
 - Children who were within 2 km (1.2 miles) of at least one SGD well during the primary window had 1.74 times the odds of developing ALL in comparison to those near no SGD wells.
 - Children who were within 2 km (1.2 miles) of at least one SGD well during the perinatal window had 2.35 times the odds of developing ALL in comparison to those near no SGD wells.
- Children who have at least one upgradient SGD well within 2 km (1.2 miles) during the primary window had 1.94 times the odds of developing ALL in comparison to those near no SGD wells. The odds ratio decreased the farther from the SGD well the child was (1.45 times at 5 km and 1.26 times at 10 km).
- The increased odds ratio for those upgradient of an SGD well suggests that water is a potential exposure pathway for substances leading to the development of ALL.

To learn more about this study or topic, explore these links:

- Clark, C. J., Johnson, N. P., Soriano, M., Warren, J. L., Sorrentino, K. M., Kadan-Lottick, N. S., Saiers, J. E., Ma, X., & Deziel, N. C. (2022). Unconventional Oil and Gas Development Exposure and Risk of Childhood Acute Lymphoblastic Leukemia: A Case–Control Study in Pennsylvania, 2009–2017. *Environmental Health Perspectives*, 130(8). <https://doi.org/10.1289/ehp11092>
- Environmental Health Project. (2020, August). *Shale Gas Development and Cancer*. https://www.environmentalhealthproject.org/files/ugd/a9ce25_21225d818b0b476db78ce99273dd8c63.pdf
- Jost, E., Dingley, B., Jost, C., Cheung, W. Y., Quan, M. L., Bouchard-Fortier, A., Kong, S., & Xu, Y. (2021). Associations Between the Density of Oil and Gas Infrastructure and the Incidence, Stage and Outcomes of Solid Tumours: A Population-Based Geographic Analysis. *Frontiers in Oncology*, 11. <https://doi.org/10.3389/fonc.2021.757875>

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- McKenzie, L. M., Allshouse, W. B., Byers, T. E., Bedrick, E. J., Serdar, B., & Adgate, J. L. (2017). Childhood hematologic cancer and residential proximity to oil and gas development. *PLOS ONE*, 12(2), e0170423. <https://doi.org/10.1371/journal.pone.0170423>
- McKenzie, L. M., Blair, B., Hughes, J., Allshouse, W. B., Blake, N. J., Helmig, D., Milmoie, P., Halliday, H., Blake, D. R., & Adgate, J. L. (2018b). Ambient Nonmethane Hydrocarbon Levels Along Colorado's Northern Front Range: Acute and Chronic Health Risks. *Environmental Science & Technology*, 52(8), 4514–4525. <https://doi.org/10.1021/acs.est.7b05983>

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