

Endocrine Disrupting Chemicals and Shale Gas Development

DEFINITIONS AND BACKGROUND INFORMATION

Endocrine system: a collection of glands and hormones that regulate growth and development, reproduction, response to stress, sexual development, and brain function, such as emotions, memory, and learning.

Endocrine disrupting chemicals (EDCs): a chemical mixture in the environment that can interfere with hormone action.

Hormones: hundreds of chemical messengers—such as insulin, thyroid hormone, estrogen, and testosterone—that the body uses to regulate every aspect of life. Hormones act to set the stage for how the body grows, develops, ages, and responds to environmental factors throughout life.

Pituitary hormones: a small, pea-sized endocrine gland located at the base of the brain that releases several hormones and controls the function of many endocrine system glands.

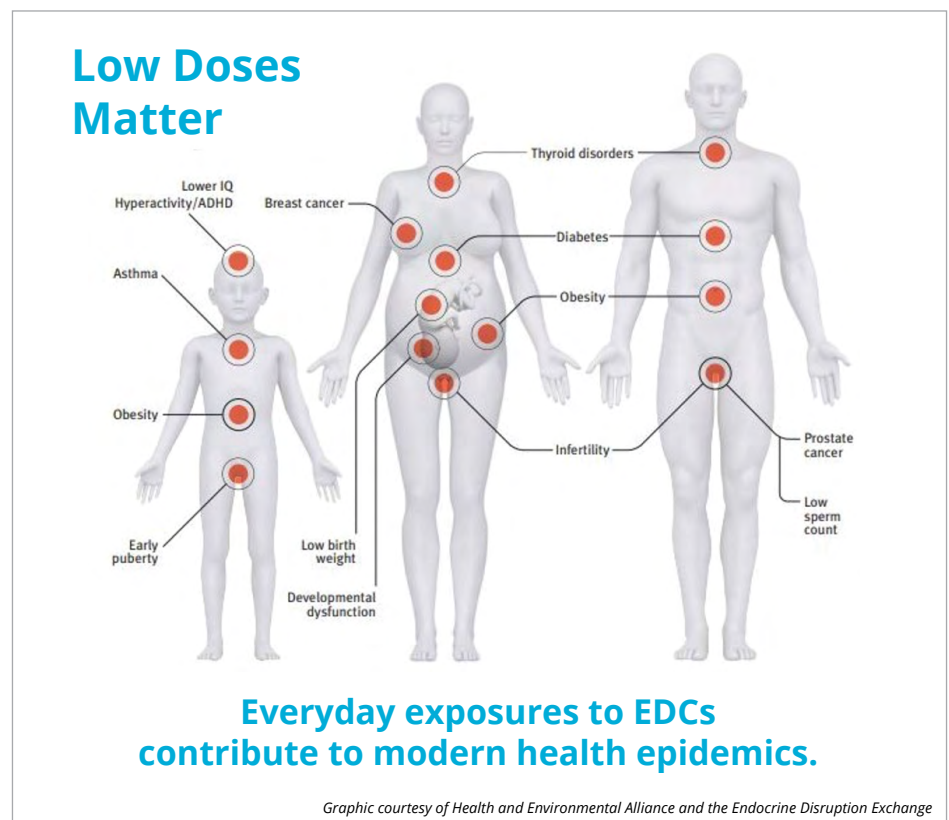
Fracturing fluid: a chemical mixture used in oil and gas drilling operations. Chemical additives include methanol, ethylene glycol, and biocides.³

A growing body of scientific research suggests that many chemicals, both natural and synthetic, interfere with hormones and the body's endocrine system. These chemicals are referred to as endocrine disrupting chemicals (EDCs). Contact with EDCs can occur through diet, air, skin, and water.¹ Studies indicate that shale gas development (SGD)—sometimes called fracking—uses and produces EDCs. People exposed to these chemicals can have a wide range of negative health impacts.

HOW DO EDCS IMPACT OUR HEALTH?²

Health effects from EDCs may occur at any age but can vary depending on when exposures occur in life. For example, fetal development, early childhood, and puberty are critical periods for exposure because rapid growth and development controlled by hormones are occurring then.

Since hormones work in very tiny amounts, even small exposures to EDCs can affect body function. EDCs may have a very different effect at high versus low levels of exposure, but both disrupt normal hormone function in a harmful way.



Endocrine disrupting chemicals have been identified in fracturing fluid and in the wastewater and air emissions generated during the SGD process. Research in recent years has resulted in a greater understanding of the actions of EDCs, but it is not always known how EDCs work, even

when EDC exposure has been linked to negative health impacts, as in the following studies:

- Nagel et al. (2020)⁴ reviewed experimental studies that evaluated the potential endocrine-mediated health impacts of exposure to a mixture of 23 unconventional oil and gas (UOG) chemicals commonly found in wastewater. They found that UOG chemicals and wastewater disrupted hormone receptors in diverse body systems. Notably, the UOG chemical mix:
 - Altered sperm counts, ovarian function, and pituitary hormones in adulthood
 - Induced mammary gland changes and development of precancerous lesions
- Bolden et al. (2018)⁵ reviewed existing studies that measured air pollutants emitted near UOG activity to generate a list of 106 chemicals that appeared in at least two studies. Twenty-one of the chemicals have been shown to disrupt endocrine activity and may impact the production of hormones. The authors

note that EDCs can have negative impacts at low exposure concentrations, resulting in less than optimal developmental, behavioral, reproductive, and metabolic conditions.

Visit environmentalhealthproject.org/endocrine-disruption to read more of the research on EDCs.

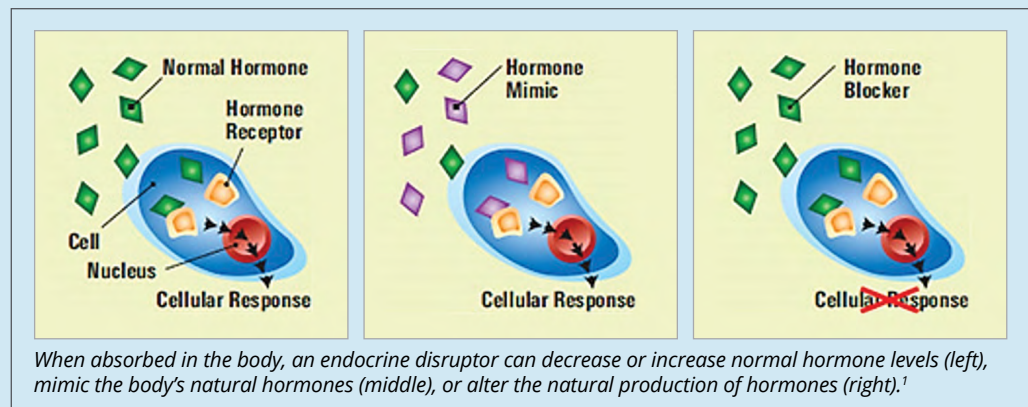
Examples of recognized health effects of EDCs include:⁶

- Abnormal development of sex organs
- Reduced ability to have children
- Changes to secondary sex characteristics, such as those that develop in puberty (e.g., underarm hair)
- Cancers such as breast, ovarian, prostate, testicular
- Impaired intellectual development
- Altered behavior or response to stress
- Increased buildup of fat and changes in ability to respond to insulin and regulate blood sugar

EDCs disrupt normal hormone signals in two main ways:

1. They change the amount of a hormone available by altering production, metabolism, or secretion.
2. They mimic or block the action of hormones and their receptors at target issues.

Graphic courtesy of the National Institute of Environmental Health Sciences, 2023



¹ National Institute of Environmental Health Sciences. (2023, March 8). *Endocrine Disruptors*. <https://www.niehs.nih.gov/health/topics/agents/endocrine/>

² U.S. Environmental Protection Agency. (2023, March 13). *Overview of Endocrine Disruption*. <https://www.epa.gov/endocrine-disruption/overview-endocrine-disruption>

³ Natural Resources Defense Council. (2019, April 19). *Fracking 101*. <https://www.nrdc.org/stories/fracking-101#what-is>

⁴ Nagel, S. C., Kassotis, C. D., Vandenberg, L. N., Lawrence, B. P., Robert, J., Balise, V. D. (2020). Developmental exposure to a mixture of unconventional

oil and gas chemicals: A review of experimental effects on adult health, behavior, and disease. *Molecular and Cellular Endocrinology*, 513:110722. <https://doi.org/10.1016/j.mce.2020.110722>

⁵ Bolden, A. L., Schultz, K., Pelch, K. E., Kwiatkowski, C. F. (2018). Exploring the endocrine activity of air pollutants associated with unconventional oil and gas extraction. *Environmental Health*, 17, 26. <https://doi.org/10.1186/s12940-018-0368-z>

⁶ Endocrine Society. (2022, August 11). *Endocrine-Disrupting Chemicals (EDCs)*. <https://www.endocrine.org/patient-engagement/endocrine-library/edcs>

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