Birth Outcomes Associated with Exposure To unconventional oil & gas development (UOGD): A scoping review of epidemiologic studies

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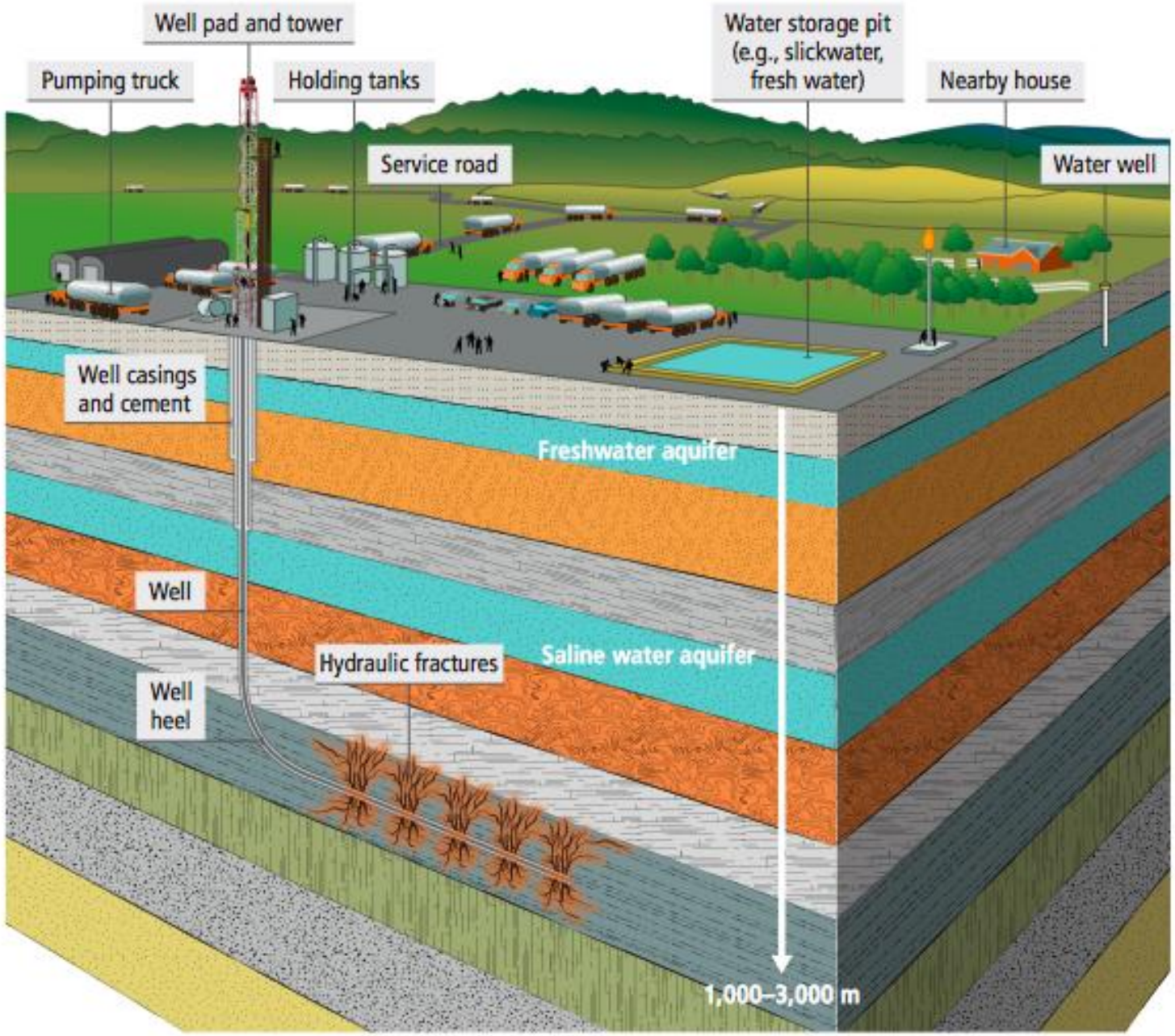
Research Team

Who is on our research team?

- Toxicologist (Elyse Caron-Beaudoin)
- Epidemiologists (Amira Aker, Lisa Ronald, Tim Takaro)
- Health services & policy researchers (Margaret McGregor, Michael Friesen)
- Environmental Consultant (Karen Leven)
- Family Physicians (Ulrike Meyer, Margaret McGregor, Willow Thickson)
- Indigenous Physician Scientist (Willow Thickson)
- Public & Environmental Health Specialist (Tim Takaro)
- Librarian (Mimi Doyle-Waters)

Background:
What Is UOGD?



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Chemicals & substances reported in higher levels in the air, water and soil near UOGD activities

- Volatile organic compounds (VOCs)
- Heavy metals (Barium, Strontium)
- Polyaromatic hydrocarbons (PAHs)
- Pollution - Particulate matter (PM2.5, PM10.0), Ozone (03)
- Radioactive elements naturally occurring in the rock formation (NORMS)

Background:

What are the health concerns related to UOGD?

Potential Health Hazards from Shale Gas Exploration and Exploitation: Drinking Water and Ambient Air.
Carrier 2012: Presented to Health Canada[1]

TABLE 7: Chemical Additives of Concern for Human Health that Were Used in Hydraulic Fracturing Products between 2005 and 2009

Chemical Additives	Chemical Category[1]	Number of Products Using the Chemical Additive (n=652)
Diesel (containing BTEX)	Carcinogen, SDWA, CAA	51
Ethylbenzene	Carcinogen, SDWA, CAA	28
Benzene	Carcinogen, SDWA, CAA	3
Di (2-ethylhexyl)phthalate	Carcinogen, SDWA, CAA	3
Acrylamide	Carcinogen, SDWA, CAA	2
Lead	Carcinogen, SDWA, CAA	1
Naphthalene	Carcinogen, CAA	44
Formaldehyde	Carcinogen, CAA	12
Benzyl chloride	Carcinogen, CAA	8
Acetaldehyde	Carcinogen, CAA	1
Ethylene oxide	Carcinogen, CAA	1
Propylene oxide	Carcinogen, CAA	1
Sulphuric acid	Carcinogen	9
Thiourea	Carcinogen	9
Nitrilotriacetic acid	Carcinogen	6
Xylene	SDWA, CAA	44
Toluene	SDWA, CAA	29
Copper	SDWA	1
Methanol (Methyl alcohol)	CAA	342
Ethylene glycol (1,2-ethanediol)	CAA	119
Hydrogen chloride (Hydrochoric acid)	CAA	42
Diethanolamine (2,2-iminodiethanol)	CAA	14
Cumene	CAA	6
Dimethyl formamide	CAA	5
Phenol	CAA	5
Hydrogen fluoride (Hydrofluoric acid)	CAA	2
Phthalic anhydride	CAA	2
Acetophenone	CAA	1
p-Xylene	CAA	1

Source: Waxman, *et al.* (2011), IARC
Blue lines correspond to carcinogen additives.
1. Carcinogen: known or possible human carcinogens;
SDWA: regulated under the Safe Drinking Water Act for their risks to human health;
CAA: Listed as hazardous air pollutants under the Clean Air Act.

How do these substances escape into the environment?

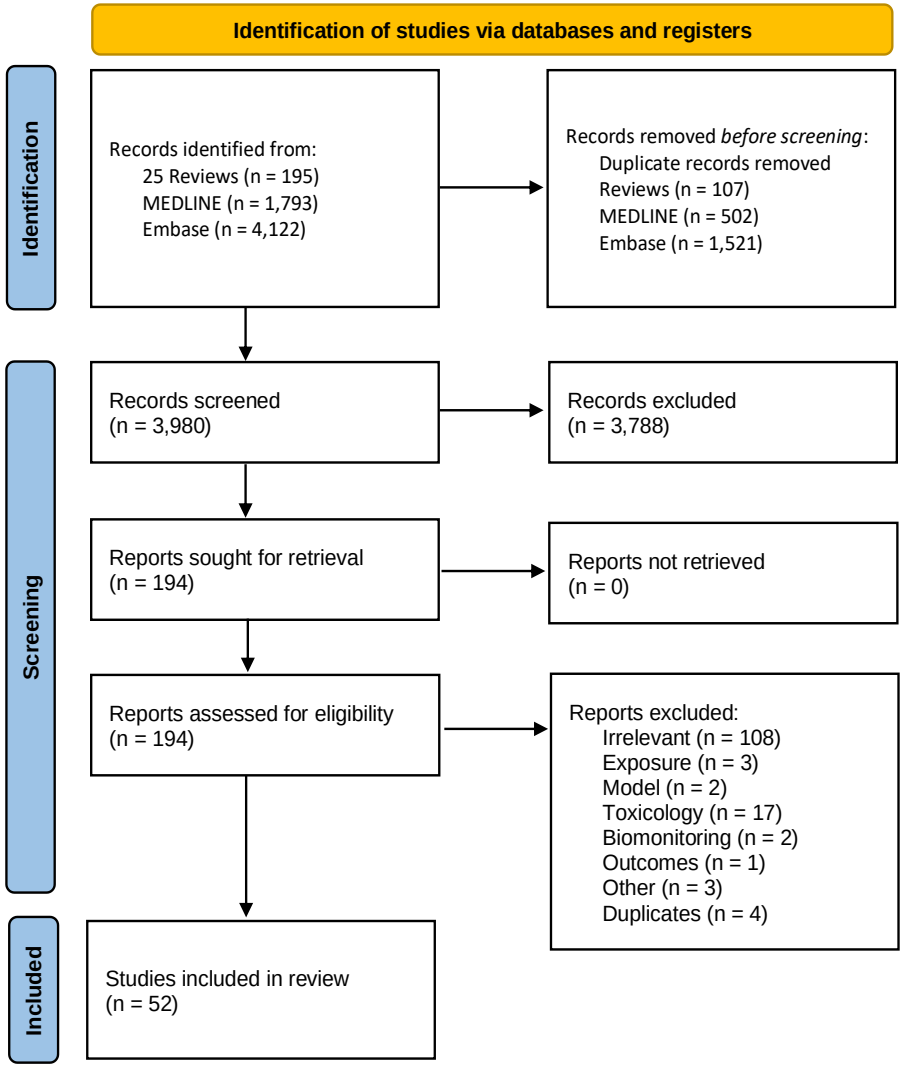
Agent/ Chemical	Described exposure routes through air, soil and/ or water
Volatile organic compounds (VOCs) (benzene, toluene, etc.)	frack fluid spills, disruption of pipe casing, wastewater spills, wastewater ponds
Heavy metals	frack fluid spills, disruption of pipe casing, wastewater spills
Polyaromatic Hydrocarbons (PAHs)	disruption of pipe casing, truck traffic and compressor station engines, venting and flaring
Pollution (PM2.5, PM 10.0, 03)	truck traffic and compressor stations, venting and flaring
Naturally occurring radioactive material (NORMs)	disruption of pipe casing, wastewater spills

Main Objective

Conduct a scoping review to identify the extent of epidemiologic research assessing UOGD chemical exposure-related health impacts

Summary of selected studies included in scoping review

January 2000 – December 2022



UOGD activity and maternal/ infant studies grouped by similar outcomes:

	Lower average birthweight (continuous)	Low birthweight (categorical)	Small-for-gestational-age	Preterm birth	Poor infant health index	Oral clefts	Neural tube defects	Congenital heart defects	Any birth defect	Fetal/infant mortality	Any adverse pregnancy or birth outcome
Number of studies w/ significantly harmful effect	**11/15**	**7/8**	**6/11**	**9/14**	**3/3**	**0/4**	**2/4**	**4/5**	**5/7**	**2/2**	**22/24**
Number of unique settings	**6**	**5**	**6**	**7**	**2**	**3**	**3**	**4**	**5**	**3**	**8**

Study Results – Overview

- A majority (n=27) used retrospective and case control designs

- Almost half (n=24) focused on birth outcomes with a majority reporting one or more significant association(s) between UOGD and: low birthweight; small for gestational age; preterm birth; and one or more birth defects

Study Results - Overview

- 73% of studies published *after* 2017
- Consistency
- Biological plausibility

Environmental Justice: a look at whose voices/experiences were missing in the analysis?

- Deployed community-based methodologies and/or other strategies anywhere in their research processes

- Measured exposure distribution by systemically disadvantaged populations

- Measured differences in health outcomes associated with UOGD by structurally and systemically excluded populations.

Systemically disadvantaged populations defined as: Indigenous, racialized, rural, and lower income communities within the study population of a given study.

Overall Summary:

- An accumulating weight of evidence of exposure to UOGD and health harms in relation to adverse birth outcomes

- Researchers need to do better with integrating environmental justice approaches into this research

Publications

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