HB22-1348 Oil and Gas Chemical DisclosureNancy York to Samantha.Falco, alex.valdez.house, edie.hooton.house, tracey.bernett.house, lisa.cutter.house, meg.froelich.house, Ron.Hanks.house, emily.sirota.house, matthew.soper.house, brianna.titone.house, mike.weissman.house, perry.will.house, Dan.Woog.house
04/14/2022 02:15 PM

Greetings,

I am delighted that the legislature is working to improve oversight of chemicals used by the oil and gas industry and strongly support passage of HB22-1348, OIL AND GAS CHEMICAL DISCLOSURE. The goal is to protect human and environmental health.

If passed Colorado's O&G industry will be required to fully disclose the chemicals used in their operations, and importantly, require certification from chemical manufacturers that Perfluoroalkyl and Polyfluoroalkyl chemicals, PFAS, are not being used. At the same time, proprietary combination of chemicals that make up the O&G product will not be compromised.

PFAS are known as "forever chemicals" as they do not break down easily. PFAS have been linked to an array of serious health impacts such as reproductive problems, hormone disruption, cancer, and thyroid, liver, kidney and pancreas damage, even in small doses.

It has been reported that 99% of Americans, including babies, have PFAS in our blood. According to the Colorado Sun, Colorado may have the most PFAS contaminated sites of any state due to so many O&G sites.

Please support greater chemical transparency in this bill. While requiring the reporting such chemicals to local government officials, neighbors and the public, HB22-1348 will still not compromise O&G proprietary chemical combinations. This is a "win win" situation.

Thank you for public service.

Best regards,

Nancy York
Larimer County

DENVER METRO CHAMBER OF COMMERCE

HB22-1348 Oversight Of Chemicals Used In Oil & Gas

Thursday, April 14, 2022
Energy & Environment 1:30 pm | Room LSB-A
Written Testimony: Oppose

Mr. Chair and fellow committee members. My name is Summer Hill, and I'm a Government Affairs Manager at the Denver Metro Chamber of Commerce. The following comments are submitted on behalf of the Chamber.

For 154 years, the Denver Metro Chamber of Commerce has been a leading voice for Colorado's business community, advocating for sound policy that strengthens our economy and makes our state the best place to live, work and do business.

We are writing today to express the Chamber's opposition to HB22-1348.

Protecting Coloradans is a high priority for the Chamber and our members. We also support and promote initiatives that contribute to a healthy lifestyle for Colorado residents. However, we feel that HB22-1348 is duplicative of other regulations and standards that are already administered by the Department of Public Health and Environment to track chemicals that may harm our community.

Additional and unnecessary legislation is a waste of taxpayer dollars and would create more barriers for businesses that are already participating in the effort to keep Colorado safe.

We urge the members of this committee to vote no on this bill.

Support of HB22-1348 Oversight of Chemicals used in Oil and GasPATRICIA to:
committees.lcs.ga@state.co.us 04/14/2022 09:45 AM
Cc: "Donato Perl", "Patricia Nelson", "Carl Erikson"

1 Attachment

Proximity to fracking and adverse birth outcomes.pdf

House Energy and Environment Committee:
I am pleased that you are considering this bill for oversight of the chemicals used in Oil and Gas. It is now known that oil and gas production is a health risk for those who live nearby. I am attaching one study that supports the claim that living in proximity to hydraulic fracturing sites is associated with adverse birth outcomes.

I believe that this bill is a good step towards knowing what chemicals we are exposed to and ultimately towards making Colorado a healthful environment for all of us.

Thank you for considering this bill.
Sincerely,
Patricia Anne Califana
1907 14th Ave.
Greeley, CO 80631

JAMA Pediatrics | Original Investigation

Association Between Residential Proximity to Hydraulic Fracturing Sites and Adverse Birth Outcomes

Zoe F. Cairncross, MPH; Isabelle Couloigner, PhD; M. Cathryn Ryan, PhD; Carly McMorris, PhD; Lucija Muehlenbachs, PhD; Nickie Nikolaou, LLM; Ron Chik-Kwong Wong, PhD; Selwynne M. Hawkins, BSc; Stefania Bertazzon, PhD; Jason Cabaj, MD; Amy Metcalfe, PhD

IMPORTANCE The association between hydraulic fracturing and human development is not well understood. Several studies have identified significant associations between unconventional natural gas development and adverse birth outcomes; however, geology and legislation vary between regions.

OBJECTIVE To examine the overall association between residential proximity to hydraulic fracturing sites and adverse birth outcomes, and investigate whether well density influenced this association.

DESIGN, SETTING, AND PARTICIPANTS This population-based retrospective cohort study of pregnant individuals in rural Alberta, Canada, took place from 2013 to 2018. Participants included reproductive-aged individuals (18-50 years) who had a pregnancy from January 1, 2013, to December 31, 2018, and lived in rural areas. Individuals were excluded if they lived in an urban setting, were outside of the age range, or were missing data on infant sex, postal code, or area-level socioeconomic status.

EXPOSURES Oil and gas wells that underwent hydraulic fracturing between 2013 to 2018 were identified through the Alberta Energy Regulator (n = 4871). Individuals were considered exposed if their postal delivery point was located within 10 km of 1 or more wells that was hydraulically fractured during 1 year preconception or during pregnancy.

MAIN OUTCOMES AND MEASURES Outcomes investigated were spontaneous and indicated preterm birth, small for gestational age, major congenital anomalies, and severe neonatal morbidity or mortality.

RESULTS After exclusions, the sample included 26 193 individuals with 34 873 unique pregnancies, and a mean (SD) parental age of 28.2 (5.2) years. Small for gestational age and major congenital anomalies were significantly higher for individuals who lived within 10 km of at least 1 hydraulically fractured well after adjusting for parental age at delivery, multiple births, fetal sex, obstetric comorbidities, and area-level socioeconomic status. Risk of spontaneous preterm birth and small for gestational age were significantly increased in those with 100 or more wells within 10 km.

CONCLUSIONS AND RELEVANCE Results suggest that individuals who were exposed to hydraulic fracturing within pregnancy may be at higher risk of several adverse birth outcomes. These results may be relevant to health policy regarding legislation of unconventional oil and gas development in Canada and internationally.

Supplemental content

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Hydraulic fracturing, commonly referred to as *fracking*, is a component of a cost-efficient technology used to drill horizontal wells that extract gas from unconventional (eg, shale) formations.[1,2] Although the relationship between hydraulic fracturing and human development is not well understood, members of the public and environmental groups have expressed concern over potential adverse health outcomes.[3] Presently, the World Health Organization classifies the association between fracking and human health as "mostly unknown."[4] Legislation and regulations attempt to mitigate the health and environmental hazards of hydraulic fracturing; nonetheless, exposure to potential exposures cannot be entirely eliminated through the regulatory regime alone.[5] Hydraulic fracturing may be associated with individual health through several processes: drilling, extraction, and the use of toxic chemicals may lead to groundwater contamination, and heavy truck traffic may create additional air pollution.[6,7]

Few studies have examined the association between residential exposure to hydraulic fracturing and human reproductive outcomes. In a 2019 systematic review, significant associations were identified between unconventional natural gas development and preterm birth,[2,8,9] infant mortality,[10] low birth weight,[8,11,12] and small for gestational age (SGA).[2,8,9] Most of these studies were conducted in the US; hence their findings might not be generalizable to other countries.

Our objectives were 3-fold: (1) to examine the association between residential proximity to hydraulic fracturing sites and adverse birth outcomes in Alberta, Canada, (2) to investigate the influence of well distance and well density on this association, and (3) to conduct sensitivity analyses measuring the influence of timing of exposure on this association.

Key Points

Question Is residential proximity to hydraulic fracturing sites associated with adverse birth outcomes?

Findings In this population-based cohort study including all reproductive-aged individuals who had a pregnancy in rural Alberta, Canada, from 2013 to 2018, those individuals living within 10 km of 100 or more hydraulically fractured wells during 1 year preconception or pregnancy had a significantly increased risk of spontaneous preterm birth and small for gestational age birth.

Meaning In this study, living in proximity to a high density of hydraulic fracturing sites was associated with adverse birth outcomes.

Methods

Study Setting and Sample

Alberta is Canada's fourth largest province with a population of 4.4 million and approximately 50 000 births annually.[13] More than 450 000 energy wells have been drilled in Alberta, of which more than 150 000 are presently active.[14,15] Wells are considered active if they have had production of oil or gas in the last 12 months. Current legislation requires that sites be at least 100 m away from residential locations.[16]

We conducted a population-based cohort study including all reproductive-aged individuals (18-50 years) who were living in a rural area and had a pregnancy between January 1, 2013, and December 31, 2018, in Alberta, Canada. Individuals were excluded if they did not live in a rural area, and if they were missing data on infant sex, postal code, or area-level socioeconomic status. No pregnant individuals living in urban areas resided within 10 km of a hydraulically fractured well. Rural residence was determined by 6-digit postal code, wherein the occurrence of a numeral 0 in the second digit of a postal code indicates a rural residence.[17]

This study received ethical approval from the Health Research Ethics Board of Alberta, Cancer Committee (REB19-0631). Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines were used. Informed consent was waived given secondary analysis of deidentified data.

Data Sources

Information about wells that were hydraulically fractured in Alberta from 2013 to 2018 was downloaded from the Alberta Energy Regulator (AER) website.[18] Unique well identifier (UWI), production type, fracture start/end date, chemicals that were used, volume of water that was used, and bottom hole geographic (North American Datum of 1983) locations were available. In 2013, the AER mandated that all companies must report details of every hydraulic fracturing job in Alberta. The data are regularly inspected and audited to ensure compliance.[19] The wellhead geographic locations and their status were obtained from GeoSCOUT using the UWIs for wells that were hydraulically fractured. As the health data were made available at the postal-code level, delivery postal points shapefile (Developing Mathematical Thinking Institute [DMTI] Spatial Inc) was downloaded from the University of Calgary digital library, which provided the geographic locations of the delivery points. Delivery points correspond to the local postal delivery units where the mail delivery person sorts the mail for their route.

Scrambled personal health numbers, sex, and dates of birth were used to deterministically link mothers and children across administrative health data holdings. Data on health outcomes and residential location were obtained from Alberta Health and Alberta Health Services. The Physician Claims database includes all fee-for-service billing data for outpatient physician visits, including the date of the visit and diagnosis/procedure codes.[20] The Discharge Abstract Database and the National Ambulatory Care Reporting System contain data on acute hospitalizations and emergency department visits, respectively.

Exposure

Using ESRI ArcGIS, version 10.5, all data were projected into North American Datum of 1983/10TM AEP (resources), a projected coordinated reference system for province-wide spatial data management and mapping as defined by information from the government of Alberta.[21] Unique postal delivery points (n = 504) were found for Alberta by cropping the DMTI

postal delivery points shapefile to the province of Alberta (CanMap Postal Code Suite, DMTI Spatial Inc). The distance (in meters) between the surface location of hydraulically fractured wells within 10 km of postal delivery points, and the angle of the vector between the surface location of those wells and the delivery points were then calculated. The tabular data from postal points, GeoSCOUT, and the AER were linked using the UWI for further analyses with the health data. Maps of the surface locations of hydraulically fractured wells and of the postal delivery points were created for visualization.

Individuals were considered exposed if their postal delivery point was located within 10 km from at least 1 active well that was hydraulically fractured during preconception (1 year prior to conception date) and/or pregnancy (conception date to delivery date). A distance of 10 km or less was chosen to ensure adequate sample size and maintain comparability with other studies.[11,22] Several characteristics were determined for each pregnancy: (1) distance to the nearest well active during preconception or pregnancy from their postal delivery point, (2) the number of wells within a 10-km radius of their postal delivery point (1-24, 25-49, 50-74, ≥100), (3) whether exposure occurred in preconception, pregnancy, or both, and (4) if exposed in pregnancy, whether exposure occurred in the first, second, third, or multiple trimesters.

Outcomes

Outcomes investigated were spontaneous and indicated preterm birth (< 37 weeks' gestation), SGA, major congenital anomalies, and severe neonatal morbidity/mortality. Spontaneous preterm birth is defined as preterm labor with cervical dilation or preterm rupture of membranes, while indicated preterm birth is defined as births induced or delivered by cesarean birth owing to parental or fetal illness. Indicated preterm births were identified based on a Canadian Classification of Health Interventions code for labor induction in conjunction with a validated algorithm for identifying prelabor cesarean delivery.[23-26] SGA, defined as newborn weight below the 10th percentile for gestational age, was determined based on Canadian reference standards.[27] Major congenital anomalies easily visible or diagnosed at birth were identified using a validated algorithm.[28] Severe neonatal morbidity/mortality was measured using the neonatal adverse outcome indicator, a validated algorithm that combines diagnosis and procedure codes related to the occurrence or treatment of severe events in the first 28 days after delivery.[29]

Covariates

Covariates included in our analyses were parental age at delivery, multiple births (ie, twins, triplets), infant sex, obstetric comorbidities, and area-level socioeconomic status. Obstetric comorbidities were identified using a validated composite measure that includes preexisting physical comorbidities, pregnancy-related conditions, and substance-related conditions.[30,31] Area-level socioeconomic status at the postal-code level was measured using the Pampalon Index, a composite score comprising 6 indices of material and social deprivation.[32,33] The score is divided into quintiles within Alberta, with quintile 1 representing the least deprived areas (highest socioeconomic status), and quintile 5 representing the most deprived areas (lowest socioeconomic status).

Statistical Analyses

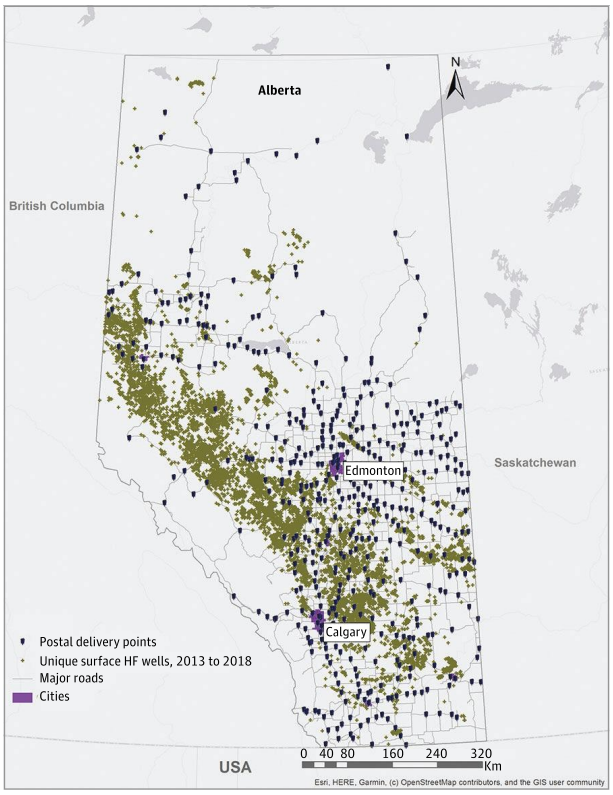
Descriptive characteristics were computed using frequencies and percentages. Modified Poisson regression was used to derive adjusted risk ratios (aRRs) with 95% CIs for all analyses. The modified Poisson model uses a sandwich variance estimator to compute risk ratios of independent binary outcomes.[34] Models were further fitted using generalized estimating equations to account for correlation within those individuals who had multiple unique pregnancies in the time frame of the study. We first measured the overall association between living within 10 km or less of a well hydraulically fractured during preconception or pregnancy and adverse birth outcomes compared with individuals who lived 10 km or more from the closest well (the referent). To evaluate whether there was a stronger association in those who lived closer to wells, we investigated the association between each outcome and the continuous distance in kilometers to the nearest well, among the exposed cohort. We then investigated well density by measuring the association between the number of wells within 10 km (1-24, 25-49, 50-74, 75-99, ≥100 wells) and each outcome.

Additionally, 2 sensitivity analyses were completed to evaluate whether associations differed depending on timing of exposure. The first investigated associations with outcomes when exposed in preconception alone, pregnancy alone, or both preconception and pregnancy, compared with those unexposed. The second investigated associations with SGA, neonatal morbidity/mortality, and any outcome when exposed in first, second, third, or multiple trimesters compared with those unexposed. Spontaneous and indicated preterm birth were not evaluated owing to risk of immortal time bias.[35-37] Complete case analysis was used. Statistical analyses were conducted using SAS version 9.4 (SAS Institute Inc).

Results

A visualization of the 504 unique postal delivery point locations and the unique surface wells that underwent hydraulic fracturing between 2013 to 2018 in Alberta is presented in **Figure 1**. Of the 4871 unique surface wells that underwent hydraulic fracturing between 2013 and 2018, 226 of the 504 postal delivery points were less than 10 km from a well, with an average of 32 wells per postal point (range, 1-310). Descriptive characteristics of the study sample are presented in **Table 1**. After exclusions for missing postal codes (n = 1845), urban residence (n = 260 319), age outside 18 to 50 years (n = 691), missing infant sex (n = 65), missing area-level socioeconomic status (n = 4605), and living within 10 km of a hydraulic fracturing site without exposure during preconception or pregnancy (n = 6505), 26 193 individuals had 34 873 unique pregnancies during the study period. Comparisons of descriptive data for those with and without missing postal code data are presented in eTable 1 in the Supplement. Twenty-seven percent (n = 9158) were exposed to hydraulic fracturing within 10 km during preconception or pregnancy.

Figure 1. Visualization of Unique Surface Wells That Underwent Hydraulic Fracturing (HF) Between 2013 and 2018



Labeled are the second most populous and the capital city of Alberta, Canada (Edmonton) and the most populous city in Alberta, Canada (Calgary).

Table 1. Descriptive Characteristics of the Study Sample (N = 34 873)

Characteristic	No. (%)
Parental age at delivery, mean (SD), y	28.2 (5.2)
Birth weight, mean (SD), g	3390 (565)
Obstetric comorbidities, any	10 557 (30.3)
Infant sex	
Male	17 908 (51.4)
Female	16 965 (48.7)
Multiple births	478 (1.4)
Gestational age at delivery, wk	
<32	401 (1.2)
32-33	312 (0.9)
34-36	1904 (5.5)
37-38	9357 (26.8)
39-40	18 693 (53.6)
≥41	4196 (12.0)
Area-level SES, quintile	
1st (Highest SES)	926 (2.7)
2nd	3527 (10.1)
3rd	5387 (15.5)
4th	9072 (26.0)
5th (Lowest SES)	15 961 (45.8)
Adverse birth outcomes	
Spontaneous preterm birth	1655 (4.8)
Indicated preterm birth	972 (2.8)
Small for gestational age	2355 (6.8)
Major congenital anomalies	257 (0.7)
Severe neonatal morbidity or mortality	2543 (7.3)

Abbreviation: SES, socioeconomic status.

Table 2 presents frequencies of each outcome, as well as crude and aRRs for exposure to a hydraulic fracturing site within 10 km in preconception or pregnancy compared with those unexposed. Among those exposed, there was a significant association with an increase in SGA (aRR, 1.12; 95% CI, 1.03-1.23) and major congenital anomalies (aRR, 1.31; 95% CI, 1.01-1.69). eTable 2 in the Supplement presents the crude and aRRs for the association between distance to the nearest well as a continuous measure and adverse birth outcomes among the exposed cohort. No association was found between any of the adverse birth outcomes and distance to the nearest well.

Figure 2 and eTable 3 in the Supplement present aRRs of each outcome comparing the association of the number of hydraulic fracturing wells within 10 km (1-24, 25-49, 50-74, 75-99, ≥100) using 1 to 24 wells as the reference. In individuals exposed to and living with 100 or more wells within 10 km (n = 414) there was an association with an increased risk of spontaneous preterm birth (aRR, 1.64; 95% CI, 1.04-2.60) and SGA (aRR, 1.65; 95% CI, 1.10-2.48). No association was found at any other level of exposure (25-49, 50-74, 75-99 wells) for any of the adverse birth outcomes.

Results of the first sensitivity analysis measuring the association regarding exposure during 1 year preconception, pregnancy, both, or neither are presented in **Table 3**. No differences in risk were found for spontaneous preterm birth, indicated preterm birth, or major congenital anomalies. Exposure in both preconception and pregnancy was associated with increased risk of SGA (aRR, 1.18; 95% CI, 1.05-1.33) and severe neonatal morbidity or mortality (aRR, 1.19; 95% CI, 1.07-1.33).

Results of the second sensitivity analysis measuring the association for exposure by trimester of pregnancy are presented in eTable 4 in the Supplement. Risk of SGA was increased in those exposed in the third trimester alone (aRR, 1.22; 95% CI, 1.02-1.47) compared with those unexposed. Risk of severe neonatal morbidity or mortality was increased in those exposed in the second trimester alone (aRR, 1.25; 95% CI, 1.03-1.52).

Discussion

In this study, we measured the association between residential proximity to hydraulic fracturing sites and birth outcomes in pregnant individuals in rural Alberta, Canada. We found that the risk of SGA and major congenital anomalies was increased for pregnant individuals living less than 10 km from a hydraulically fractured well during 1 year preconception or pregnancy. Risk of any of the measured outcomes did not increase when exposure was limited to distance to the nearest well, but risk of spontaneous preterm birth and SGA were increased in those individuals living within 10 km of more than

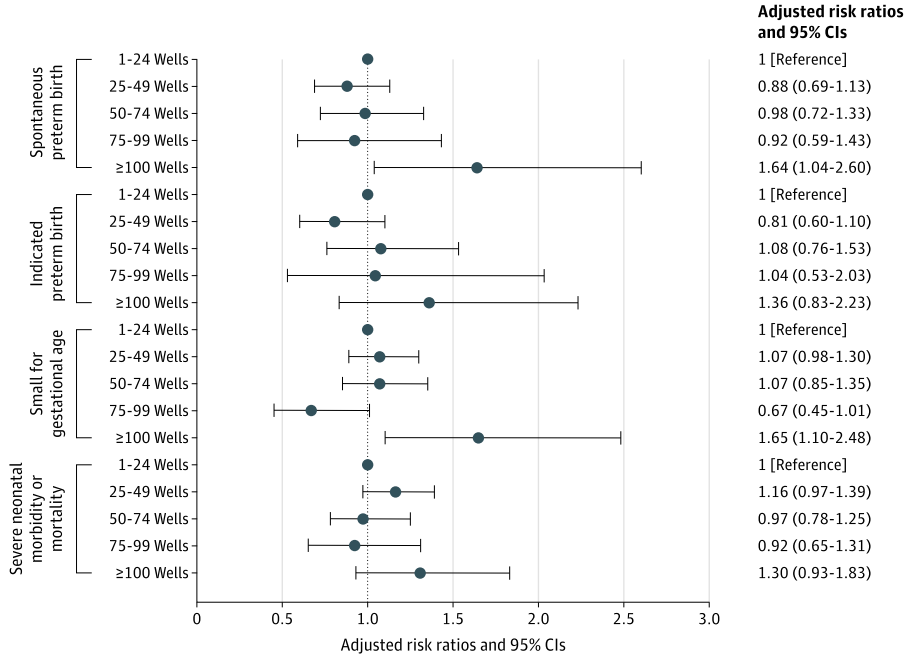
Table 2. Risk Ratios and 95% CIs for Adverse Birth Outcomes in Those Exposed Compared With Those Unexposed

Outcome	No./Total No. (%)		RR (95% CI)	
	No. exposed with outcome/total exposed (%)	No. unexposed with outcome/total unexposed (%)	Crude	Adjusted[a]
Spontaneous preterm birth	422/9158 (4.6)	1233/25 715 (4.8)	0.96 (0.86-1.07)	0.97 (0.87-1.08)
Indicated preterm birth	260/9158 (2.8)	712/25 715 (2.8)	1.03 (0.89-1.18)	1.01 (0.88-1.16)
Small for gestational age	671/9158 (7.3)	1684/25 715 (6.5)	1.13 (1.03-1.23)	1.12 (1.03-1.23)
Major congenital anomalies	82/9158 (0.9)	175/25 715 (0.7)	1.32 (1.01-1.71)	1.31 (1.01-1.69)
Severe neonatal morbidity qaor mortality	694/9158 (7.6)	1849/25 715 (7.2)	1.05 (0.97-1.15)	1.07 (0.97-1.17)

Abbreviation: RR, risk ratio.

[a] All modified Poisson regression models adjusted for parental age at delivery, area-level socioeconomic status, multiple births, infant sex, and obstetric comorbidities.

Figure 2. Forest Plot of Adjusted Risk Ratios With 95% CIs for Adverse Birth Outcomes in Pregnant Individuals



100 wells. Timing of exposure may also be relevant to the association: exposure in both the preconception period and during pregnancy showed increased risk of several adverse outcomes, but exposure in only 1 of the 2 time periods had no association. Together, these results suggest that the association of hydraulic fracturing is not in proximity but in the density of operations in a given area and the cumulative amount of exposure an individual may have.

tj;3Three key advantages arise from using data from Alberta. First is the ability to examine health outcomes associated with hydraulic fracturing in the absence of an income shock. In the US, landowners are often also the owners of the subsurface mineral rights and therefore can see large windfalls in the form of royalties and bonus payments when fracking takes place on their properties, which is a concern given income is a known confounder of birth outcomes.[38,39] In Alberta, most minerals are owned by the Crown and therefore beyond a small surface lease payment, we do not expect household income to change with nearby fracking.[40] Second, by focusing on Alberta, bias arising from self-selection into treatment was less of a concern. In the US context, many households own the subsurface minerals, which means they have the choice of whether to allow drilling on their properties, a choice that could be correlated with factors also influencing health outcomes.[38] Crown ownership of minerals in Alberta means that households do not have the choice as to whether a well will be drilled on their property.[40,41] Third, the high density of drilling in Alberta provided unique variation in the extent to which mothers were exposed. We observed large variation in the number of wells fracked nearby, allowing us to examine differential associations by development intensity.

Our study adds to a growing body of literature in which several studies have found associations between unconventional oil and gas development and adverse birth outcomes. To our knowledge, only 1 other study of this type has been conducted in Canada; Caron-Beaudoin et al[22] investigated

Table 3. Risk Ratios and 95% CIs for Adverse Birth Outcomes in Individuals Living Within or Near a Hydraulic Fracturing Site During Preconception Compared With Those Unexposed

Outcome	Timing of exposure	RR (95% CI)	
		Crude	Adjusted[a]
Spontaneous preterm birth	Unexposed	1 [Reference]	1 [Reference]
	Preconception	1.17 (0.98-1.40)	1.18 (0.99-1.40)
	Pregnancy	0.93 (0.77-1.12)	0.92 (0.77-1.12)
	Both	0.87 (0.74-1.01)	0.88 (0.75-1.03)
Indicated preterm birth	Unexposed	1 [Reference]	1 [Reference]
	Preconception	1.16 (0.92-1.47)	1.12 (0.89-1.41)
	Pregnancy	0.79 (0.60-1.04)	0.78 (0.59-1.02)
	Both	1.09 (0.90-1.31)	1.08 (0.90-1.30)
Small for gestational age	Unexposed	1 [Reference]	1 [Reference]
	Preconception	0.99 (0.84-1.17)	0.99 (0.84-1.17)
	Pregnancy	1.15 (1.00-1.32)	1.14 (0.99-1.32)
	Both	1.19 (1.06-1.33)	1.18 (1.05-1.33)
Major congenital anomalies	Unexposed	1 [Reference]	1 [Reference]
	Preconception	1.32 (0.84-2.08)	1.34 (0.86-2.11)
	Pregnancy	1.42 (0.93-2.18)	1.43 (0.94-2.19)
	Both	1.22 (0.85-1.74)	1.19 (0.83-1.70)
Severe neonatal morbidity or mortality	Unexposed	1 [Reference]	1 [Reference]
	Preconception	1.04 (0.90-1.21)	1.05 (0.91-1.22)
	Pregnancy	0.88 (0.75-1.03)	0.89 (0.76-1.05)
	Both	1.16 (1.04-1.30)	1.19 (1.07-1.33)

Abbreviation: RR, risk ratios.

[a] All modified Poisson regression models adjusted for parental age at delivery, area-level socioeconomic status, multiple births, infant sex, and obstetric comorbidities.

hydraulic fracturing in northeastern British Columbia and identified nonlinear associations between proximity and density of hydraulically fractured wells, low birth weight, and preterm birth. All other studies of hydraulic fracturing and birth outcomes have been conducted in the US, in a different legislative, geographical, and geological context. Casey et al[2] found that residential proximity to hydraulic fracturing increased the odds of preterm birth (odds ratio, 1.4; 95% CI, 1.0-1.9) and high-risk pregnancies (odds ratio, 1.3; 95% CI, 1.1-1.7). Currie et al[11] reported that parental residential exposure to hydraulic fracturing during pregnancy was negatively associated with birth weight ($P < .001$) and a composite outcome composing low birth weight, preterm birth, congenital anomalies, and other adverse neonatal events. Hill et al[8] observed that residential proximity to hydraulic fracturing during pregnancy was associated with a 3% increase in preterm birth and a 7% increase in low birth weight.

There are multiple mechanisms whereby residential proximity may lead to human exposure to chemicals used in the fracking process and pollutants that are released into the environment.[6] Although groundwater contamination from hydraulic fracturing via subsurface pathways has not been clearly demonstrated, groundwater changes have been attributed to surface spills.[42] This is particularly important in the Alberta context, as it is estimated that for approximately 90% of rural Albertans, the primary source of drinking water is groundwater.[43] The drilling and extraction process can also lead to changes in air quality.[6] Hydraulic fracturing involves the transport of large quantities of water (majority surface-sourced in Alberta), often via heavy trucks, which could lead to increased air pollution.[6,44] Overall, thousands of chemicals are used in fracking fluids; however, only 240 of these have toxicity information available.[1,7] Of those 240 chemicals, 103 (43%) are linked to reproductive toxicity.[1,7] Thus, pregnant individuals may be especially susceptible to hydraulic fracturing exposure that occurs during critical stages of gestation.[11,45] Two biomonitoring studies have shown increased levels of contaminants associated with hydraulic fracturing in the urine and hair of pregnant individuals living in areas with high oil and gas activity.[46,47]

Limitations

Our study has several limitations. As we only know the postal code of individuals in the data set and not their exact address, their locations are approximated to the delivery point of their postal code. In less populated areas where postal codes are larger, using the delivery point may underestimate or overestimate the distance from residence to nearest well. We also have not delineated between the different phases of oil and gas production (eg, drilling, production) which have been shown to be associated with adverse birth outcomes and should be considered in future studies.[2,48] We have also used categorical rather than continuous variables to measure well density. This was decided a priori to ensure adequate sample size in each group but subsequently limits our ability to capture the true association. We encourage future groups to find optimal cut points in their analyses. Administrative health data do not capture all variables relevant to reproductive health. While we have attempted to approximate some of these variables, there are multiple confounders that we cannot control for and we acknowledge that our results do not reflect the full complexity of pregnancy-related health. For example, pregnancy morbidity is associated with lack of access to healthy food choices, a variable that cannot be properly approximated by the simplicity of rural living vs urban living.[49] An E-value analysis was completed to quantify unmeasured confounding and is included in eTable 5 in the Supplement.[50,51]

Conclusions

In this retrospective cohort study, close residential proximity to high numbers of hydraulic fracturing sites was correlated with adverse birth outcomes. Though we cannot ascertain in this analysis the mechanisms (eg, air, water) through which hydraulic fracturing and oil and gas development may be increasing the risk for adverse health outcomes, we encourage additional research to further elucidate these potential pathways.

ARTICLE INFORMATION

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Author Contributions: Dr Metcalfe and Ms Cairncross had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: Ryan, McMorris, Nikolaou, Bertazzon, Cabaj, Metcalfe.
Acquisition, analysis, or interpretation of data: Cairncross, Couloigner, Ryan, McMorris, Muehlenbachs, Nikolaou, Wong, Hawkins, Bertazzon, Metcalfe.
Drafting of the manuscript: Cairncross, McMorris, Nikolaou.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: Cairncross.
Obtained funding: Ryan, McMorris, Muehlenbachs, Nikolaou, Metcalfe.
Administrative, technical, or material support: Ryan, Chik-Kwong Wong, Metcalfe.
Supervision: McMorris, Bertazzon, Metcalfe.

Conflict of Interest Disclosures: None reported.

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Support for HB22-1218susan to Samantha.Falco 04/14/2022 12:53 PM

Re: Support for HB22-1218. EV chargers in multi-unit housing

April 14, 2022

Dear E&E committee,

As a fifth-generation Coloradoan, mother of three, and scientist, I heartily support HB22-1218 as a positive step to reduce emissions in the Front Range. As you know, our emissions are health, environment, business, and definitely a quality-of-life issue. As a consumer, I need to know that the infrastructure is there before I feel confident to buy an electric car. We must take bold steps to reduce our dependency on fossil fuels- as the war in Ukraine so poignantly demonstrates. We will be so much better off if we move swiftly to support clean energy infrastructure. I know as a scientist who has researched and taught about climate change that the difference between resisting a transition away from fossil fuels and embracing this transition, can be literally calculated in human lives. The sixth IPCC report provides the information we need. Now we must act! Please provide EV chargers for all our citizens, not just those who can afford the private chargers.
Thank you,

Susan M. Pierce
2408 23rd Ave Greeley, CO.80634

Yay for HB-22-1348susan to Samantha.Falco 04/14/2022 12:39 PM

To:
Re: HB22-1348 Oversight Of Chemicals Used In Oil & Gas | Colorado General Assembly

Dear Environment and Energy Committee,
I am a natural resource consultant, educator, and mother of three and reside in my hometown of Greeley, Colorado. I want to express my support of HB-22-1348, for the following reasons:

1) We know that some chemicals used in downhole drilling operations are extremely hazardous to human health causing thyroid disorders, cancer, and other health conditions. Air monitoring in Greeley has shown high levels of benzene in an oil rig that is only 600 feet from a school playground. Citizens deserve to know what chemicals are being used!
2) PFAs may convert to PFCs under the heat and pressure of fracking. PFCs have the potential to trap heat to the Earth's surface (Global Warming Potential) that can reach over 12,000 times that of CO2 and can persist in our atmosphere for over 50,000 years! These are entirely manmade and therefore entirely the responsibility of humankind to cease producing.
3) California has legislation that requires O&G industries to disclose the chemicals and amounts, but not the solutions (supposed trade secrets). This could easily be adopted in Colorado to protect our citizens and our environment.

Our political leader's first responsibility is to protect the well-being of us citizens, and this MUST come before the well-being of the oil and gas industry which have had record profits in the last decade.

Sincerely,
Susan M. Pierce
2408 23rd Ave.
Greeley, Colorado 80634

HB22-1348 - Fracking Chemicals including PFASJennifer Cohen to Samantha.Falco
04/13/2022 05:52 PM
History:This message has been replied to.

I have been a resident of Colorado since 1997.
This testimony is to support HB22-1348 - Oversight Of Chemicals Used In Oil & Gas

Colorado should enact this legislation for the following reasons:

- Coloradans have the right to know what chemicals are being injected into the ground in their communities.
- Policies have been successfully employed in other states and have identified highly toxic additives.
- The bill will require more detailed reporting for the public without compromising the proprietary combination of chemicals that make up the product.

Respectfully submitted
Jennifer Cohen
Boulder, CO

Fwd: Support for HB22-1348Scott Simmons to Samantha.Falco 04/12/2022 06:41 PM

---------- Forwarded message ---------
From: **Scott Simmons** <simmonsscottm@gmail.com>
Date: Tue, Apr 12, 2022 at 9:22 AM
Subject: Support for HB22-1348
To: <barbara.kirkmeyer.senate@state.co.us>, <Mike.Lynch.house@state.co.us>, Scott Simmons <simmonsscottm@gmail.com>

I am a retired software engineer and a resident of COlorado for 25 years. I am filing this testimony to support HB22-1348.

Colorado should either ban or adopt mandatory prior disclosure of all use of hazardous chemicals prior to their use in oil and gas operations for the following reasons:

- Numerous chemicals used in fossil fuel production are hazardous to human health. Coloradoans have a right to know what chemicals will be in the environment.

- In Weld and Garfield Counties, well operators shielded the identities of chemicals as a “trade secret” in thousands of wells using a staggering 384 million pounds of unidentified “trade secret” chemicals from 2011 to 2021. (Hahn, 2022).

- PFAS are “forever” chemicals because they do not break down in the environment nor in the human body. Exposure to PFAS can lead to a wide spectrum of health impacts, including kidney and testicular cancers, leukemia, and thyroid disease among others. (Hahn, 2022)

- Hahn reports that In Colorado, nearly 9,000 pounds of PTFE were used in oil and gas drilling and fracking over the past decade.

- Some PFCs can persist in the atmosphere for up to 50,000 years! They are extremely powerful greenhouse gases. Each pound of PFC has the global warming potential (GWP) of 12,200 lbs. of CO2.

For more details about PFAs in Colorado see https://www.psr.org/wp-content/uploads/2022/01/fracking-with-forever-chemicals-in-colorado.pdf

see also:

Hahn, Johnathan, 2022. Oil and Gas Companies Routinely Frack with “Trade Secret” Chemicals, Including PFAS. Sierra, February 2022.

Thank you for your support

Scott Simmons

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Scott Simmons
simmonsscottm@gmail.com
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303-638-0484

Climate Change Advocate
AAK School Board Member

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AAK School Board Member

HB22-1348, Testimony before The House Energy & Environment Committeenavegar to Samantha.Falco 04/11/2022 07:00 PM

I am a retired environmental attorney. I have been a resident of Colorado for the past 5 years. I am filing this testimony to support HB22-1348. Colorado should either ban or adopt mandatory prior disclosure of all use of hazardous chemicals prior to their use in oil and gas operations for the following reasons:

- Numerous chemicals used in fossil fuel production are hazardous to human health. Coloradoans have a right to know what chemicals will be in the environment.

- In Weld and Garfield Counties, well operators shielded the identities of chemicals as a "trade secret" in thousands of wells using a staggering 384 million pounds of unidentified "trade secret" chemicals from 2011 to 2021. (Hahn, 2022).

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see also:
Hahn, Johnathan, 2022. Oil and Gas Companies Routinely Frack with "Trade Secret" Chemicals, Including PFAS. Sierra, February 2022.

Frank Hruby
314-873-8534
Loveland Co