

Supplemental Online Content

Cairncross ZF, Couloigner I, Ryan MC, et al. Association between residential proximity to hydraulic fracturing sites and adverse birth outcomes. *JAMA Pediatr*. Published online April 4, 2022. doi:10.1001/jamapediatrics.2022.0306

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This supplemental material has been provided by the authors to give readers additional information about their work.

eTable 1. Descriptive statistics of those with (n=34,873) and without (n=1,845) postal code.

Characteristic	Postal code available	Postal code missing
Maternal age at delivery (mean, sd)	28.2 (5.2)	23.3 (6.45) ^a
Birthweight, grams (mean, sd)	3390 (565)	3015 (985)
Obstetric comorbidities, any, n (%)	10,557 (30.3)	427 (23.1)
Infant sex, n (%)		
Male	17,908 (51.4)	922 (50.1) ^b
Female	16,965 (48.7)	917 (49.9) ^b
Multiple births, n (%)	478 (1.4)	74 (4.0)
Gestational age at delivery, n (%)		
< 32 weeks	401 (1.2)	213 (11.5)
32-33 weeks	312 (0.9)	25 (1.4)
34-36 weeks	1,904 (5.5)	124 (6.7)
37-38 weeks	9,357 (26.8)	376 (20.4)
39-40 weeks	18,693 (53.6)	907 (49.2)
≥ 41 weeks	4,196 (12.0)	197 (10.7)
Area-level socioeconomic status, n (%)		
1 st quintile (highest SES)	926 (2.7)	c
2 nd quintile	3,527 (10.1)	c
3 rd quintile	5,387 (15.5)	c
4 th quintile	9,072 (26.0)	c
5 th quintile (lowest SES)	15,961 (45.8)	c
Adverse birth outcomes, n (%)		
Spontaneous preterm birth	1,655 (4.8)	285 (15.5)
Indicated preterm birth	972 (2.8)	80 (4.3)
Small for gestational age	2,355 (6.8)	164 (8.9)
Major congenital anomalies	257 (0.7)	14 (0.8)
Severe neonatal morbidity or mortality	2,543 (7.3)	336 (18.2)

^a Restricted to those between 18 and 50 years of age.

^b Restricted to those without missing data on sex.

^c Area-level SES cannot be measured without postal code.

eTable 2. Risk ratios (RR) and 95% confidence intervals (CI) for adverse birth outcomes in women living within 10km of ≥ 1 hydraulic fracturing site during preconception or pregnancy (n=9,158), using distance in kilometres from the closest hydraulic fracturing site as a continuous independent variable.

Outcome	Crude RR (95% CI)^a	Adjusted RR (95% CI)^b
Spontaneous preterm birth	1.01 (0.97-1.04)	1.00 (0.96-1.04)
Indicated preterm birth	0.99 (0.94-1.04)	0.99 (0.95-1.05)
Small for gestational age	1.00 (0.97-1.03)	1.01 (0.98-1.04)
Major congenital anomalies	1.02 (0.94-1.10)	1.02 (0.94-1.10)
Severe neonatal morbidity or mortality	1.00 (0.97-1.03)	1.01 (0.97-1.04)

^a Risk ratios represent the change in risk per 1 kilometre increase in distance from the closest hydraulic fracturing site during preconception or pregnancy.

^b All modified Poisson regression models adjusted for maternal age at delivery, SES, multiple births, infant sex, and obstetric comorbidities.

eTable 3. Risk ratios (RR) and 95% confidence intervals (CI) for adverse birth outcomes in women living within 10km of ≥1 hydraulic fracturing site during preconception or pregnancy (n=9,158), comparing the effect of number of wells in a 10km radius.

Outcome ^a	Number of wells within ten kilometers	N with outcome (%)	Crude RR (95% CI)	Adjusted RR (95% CI) ^b
Spontaneous preterm birth	1-24	224 (4.5)	1.00 [Reference]	1.00 [Reference]
	25-49	94 (4.1)	0.87 (0.69-1.11)	0.88 (0.69-1.13)
	50-74	53 (4.5)	0.95 (0.70-1.30)	0.98 (0.72-1.33)
	75-99	20 (4.0)	0.85 (0.55-1.34)	0.92 (0.59-1.43)
	≥100	31 (7.5)	1.60 (1.10-2.31)	1.64 (1.04-2.60)
Indicated preterm birth	1-24	140 (2.9)	1.00 [Reference]	1.00 [Reference]
	25-49	54 (2.4)	0.80 (0.59-1.10)	0.81 (0.60-1.10)
	50-74	37 (3.1)	1.07 (0.75-1.52)	1.08 (0.76-1.53)
	75-99	13 (2.6)	0.89 (0.46-1.73)	1.04 (0.53-2.03)
	≥100	16 (3.9)	1.32 (0.79-2.19)	1.36 (0.83-2.23)
Small for gestational age	1-24	331 (8.0)	1.00 [Reference]	1.00 [Reference]
	25-49	177 (8.9)	1.11 (0.92-1.33)	1.07 (0.98-1.30)
	50-74	92 (8.8)	1.09 (0.87-1.38)	1.07 (0.85-1.35)
	75-99	24 (5.4)	0.67 (0.45-1.00)	0.67 (0.45-1.01)
	≥100	47 (12.6)	1.58 (1.14-2.18)	1.65 (1.10-2.48)
Severe neonatal morbidity or mortality	1-24	343 (7.2)	1.00 [Reference]	1.00 [Reference]
	25-49	193 (8.4)	1.17 (0.99-1.39)	1.16 (0.97-1.39)
	50-74	84 (7.1)	0.99 (0.78-1.25)	0.97 (0.78-1.25)
	75-99	32 (6.4)	0.89 (0.63-1.26)	0.92 (0.65-1.31)
	≥100	42 (10.1)	1.41 (1.04-1.91)	1.30 (0.93-1.83)

^a Congenital anomalies could not be evaluated due to small sample size.

^b All modified Poisson regression models adjusted for maternal age at delivery, SES, multiple births, infant sex, and obstetric comorbidities.

eTable 4. Risk ratios (RR) and 95% confidence intervals (CI) for adverse birth outcomes in women living within 10km of ≥1 hydraulic fracturing site during their first trimester (n=1,154), second trimester (n=1,108), third trimester (n=1,330), or across multiple trimesters (n=3,236), compared to those unexposed (n=25,715).

Outcome ^a	Timing of exposure in pregnancy	Crude RR (95% CI)	Adjusted RR (95% CI) ^b
Small for gestational age	Unexposed	1.00 [Reference]	1.00 [Reference]
	First trimester	1.20 (0.98-1.46)	1.19 (0.97-1.45)
	Second trimester	1.18 (0.96-1.45)	1.17 (0.95-1.44)
	Third trimester	1.22 (1.01-1.46)	1.22 (1.02-1.47)
	Multiple trimesters	1.14 (1.00-1.31)	1.13 (0.99-1.30)
Severe neonatal morbidity or mortality	Unexposed	1.00 [Reference]	1.00 [Reference]
	First trimester	1.05 (0.85-1.29)	1.06 (0.86-1.31)
	Second trimester	1.24 (1.02-1.51)	1.25 (1.03-1.52)
	Third trimester	0.90 (0.73-1.11)	0.94 (0.77-1.16)
	Multiple trimesters	1.07 (0.94-1.21)	1.09 (0.96-1.24)

^a Congenital anomalies could not be evaluated due to small sample size. Spontaneous and indicated preterm birth were excluded from analyses due to risk of immortal time bias.

^b All modified Poisson regression models adjusted for maternal age at delivery, SES, multiple births, infant sex, and obstetric comorbidities.

eTable 5. E-values for each analysis with statistically significant results. E-values indicate the association a confounder would need to have with both the exposure and the outcome to entirely explain the association found.

Analysis, significant association found	E-value
Table 2. Overall association	
Small for gestational age	1.49
Major congenital anomalies	1.95
eTable 3. Density	
Spontaneous preterm birth, ≥ 100 wells	1.46
Small for gestational age, ≥ 100 wells	1.64
Table 3. Sensitivity analysis 1	
Small for gestational age, both preconception and pregnancy	2.66
Severe neonatal morbidity or mortality, both preconception and pregnancy	2.69
eTable 4. Sensitivity analysis 2	
Small for gestational age, third trimester exposure	1.74
Severe neonatal morbidity or mortality, second trimester exposure	1.81