

Supplemental Digital Content

Table S1:

Spearman Correlation Coefficients between Average Maternal Exposures to PM_{2.5} and Constituents during Pregnancy in Massachusetts from 2001 to 2012 (n = 725,919).

	PM_{2.5}	EC	OC	Nitrate	Sulfate
PM _{2.5}	1				
EC	0.44	1			
OC	0.59	0.55	1		
Nitrate	0.39	0.32	0.49	1	
Sulfate	0.72	0.35	0.46	0.38	1

Abbreviations: PM_{2.5}, particulate matter under 2.5 μm in aerodynamic diameter; EC, elemental carbon; OC, organic carbon

Table S2: Sociodemographic Comparison between Included (n=725,919) and Excluded (n=181,847) Births in Massachusetts from 2001 to 2012. P-value from a test for difference in mean or proportion between the included births and excluded births.

Variable	Included	Excluded	p-value
<i>Continuous Variables (mean ± interquartile range (IQR))</i>			
Particulate Matter under 2.5 µm in diameter (PM _{2.5}) Exposure (µg/m ³)	10.3 ± 2.0	9.7 ± 2.1	0
Elemental Carbon (EC) Exposure (µg/m ³)	0.5 ± 0.2	0.6 ± 0.2	8.4E-06
Organic Carbon (OC) Exposure (µg/m ³)	2.8 ± 1.4	2.5 ± 1.6	0
Nitrate Exposure (µg/m ³)	1.2 ± 0.5	1.0 ± 0.6	0
Sulfate Exposure (µg/m ³)	2.8 ± 1.5	2.2 ± 2.0	0
Birthweight (g)	3442 ± 624	2858 ± 1039	0
Clinical Gestational Age (weeks)	39.3 ± 1.0	40.8 ± 5.0	0
Maternal Age (years)	30.1 ± 8.6	30.4 ± 9.0	7.4E-100
Median Household Income at Census Block Group (10,000 USD/year)	6.8 ± 4.2	6.8 ± 4.2	0.046
Proportion Black Population at Census Block Group	0.08 ± 0.08	0.09 ± 0.09	3.4E-96
<i>Binary and Categorical Variables (%)</i>			
Newborn Sex = Female	49.0	48.1	1.6E-13
Parity: First-Born	45.2	42.2	2.2E-92
Mother Married	69.0	66.5	1.6E-97
Medicaid Support for Prenatal Care	32.6	34.7	1.9E-59
Maternal Smoking	14.0	12.9	1.2E-31
Gestational Diabetes	4.0	5.7	6.1E-186
Other Diabetes	0.9	1.6	2.0E-129
High Blood Pressure during Pregnancy	3.2	6.0	0
Chronic High Blood Pressure	1.2	2.3	3.8E-191
Season of Birth			
Winter	24.4	21.6	1.4E-151

Spring	25.2	27.3	1.0E-75
Summer	26.0	27.6	6.5E-44
Fall	24.4	23.5	3.6E-16
Mode of Delivery			
Vaginal	65.5	53.3	0
Forceps	0.6	0.6	0.073
Vacuum	3.6	2.4	3.8E-175
First caesarian birth	16.8	29.2	0
Repeat caesarian	12.0	13.2	2.0E-44
Vaginal birth after previous caesarean birth	1.5	1.3	7.4E-19
Maternal Race			
White	71.5	71.3	0.047
Black	8.2	12.1	0
Asian	7.5	7.0	2.2E-17
American Indian	0.2	0.3	8.6E-13
Other	12.5	9.4	0
Kessner Index for Prenatal Care			
Adequate	78.8	73.2	0
Intermediate	17.0	17.9	2.0E-15
Inadequate	3.3	3.3	0.85
No Prenatal Care	0.9	5.7	0
Maternal Education			
Less than High School	10.8	11.5	8.5E-18
High School	24.5	23.2	2.2E-34
Some College	22.0	22.8	5.0E-12
College	26.4	25.5	1.3E-14
Advanced Degree	16.3	17.1	5.6E-15

Table S3:

Estimated effects on birthweight per 1 $\mu\text{g}/\text{m}^3$ and interquartile range (IQR) increases in particulate matter under 2.5 μm in aerodynamic diameter ($\text{PM}_{2.5}$) constituent and total $\text{PM}_{2.5}$ in single constituent models and a multi constituent model in Massachusetts from 2001 to 2012 ($n = 725,919$). Single constituent models estimated, in four separate regressions for elemental carbon (EC), organic carbon (OC), nitrate, and sulfate, associations per 1 $\mu\text{g}/\text{m}^3$ increase in the constituent or remaining $\text{PM}_{2.5}$. The multi-constituent model simultaneously included all four constituents and remaining $\text{PM}_{2.5}$. Each model additionally adjusted for maternal age, race, marital status, smoking, education, parity, chronic diabetes, gestational diabetes, chronic high blood pressure, high blood pressure during pregnancy, Kessner index of adequacy of prenatal care, mode of delivery, clinical gestational age, year of birth, newborn sex, and Medicaid-supported prenatal care. IQRs ($\mu\text{g}/\text{m}^3$): EC = 0.2, OC = 1.4, Nitrate = 0.5, Sulfate = 1.5, $\text{PM}_{2.5} = 2.0$.

		Association with Birthweight (g)	
		per 1 $\mu\text{g}/\text{m}^3$ increase in Pollutant	per IQR increase in Pollutant
Single Constituent Models			
<i>EC</i>			
	EC	-43.89 (-50.16, -37.63)	-9.88 (-11.29, -8.47)
	$\text{PM}_{2.5}$	-3.66 (-5.00, -2.32)	-7.47 (-10.21, -4.74)
<i>OC</i>			
	OC	-3.89 (-5.22, -2.56)	-5.26 (-7.05, -3.46)
	$\text{PM}_{2.5}$	-5.24 (-6.59, -3.88)	-10.68 (-13.44, -7.93)
<i>Nitrate</i>			
	Nitrate	-14.37 (-18.17, -10.57)	-7.78 (-9.84, -5.72)
	$\text{PM}_{2.5}$	-5.36 (-6.67, -4.05)	-10.94 (-13.62, -8.27)
<i>Sulfate</i>			
	Sulfate	-2.42 (-4.42, -0.43)	-3.74 (-6.82, -0.66)
	$\text{PM}_{2.5}$	-6.38 (-7.66, -5.09)	-13.01 (-15.63, -10.40)
Multi-Constituent Model			
	EC	-41.18 (-48.20, -34.15)	-9.27 (-10.85, -7.69)
	OC	0.42 (-1.11, 1.95)	0.57 (-1.49, 2.64)
	Nitrate	-6.44 (-10.74, -2.14)	-3.49 (-5.81, -1.16)
	Sulfate	0.20 (-1.83, 2.23)	0.31 (-2.83, 3.44)
	$\text{PM}_{2.5}$	-3.47 (-4.85, -2.09)	-7.07 (-9.89, -4.26)

Figure S1:

Assessment of Confounding by Covariates in the Relationship between Maternal Exposure to Particulate Matter under 2.5 μm in Aerodynamic Diameter ($\text{PM}_{2.5}$) during Pregnancy and Continuous Birthweight in Massachusetts from 2001 to 2012 ($n = 725,919$). Estimated changes in continuous birthweight along with the 95% confidence intervals are shown. The estimate for the full model is shown in red and the estimates for models omitting the covariate are in black.

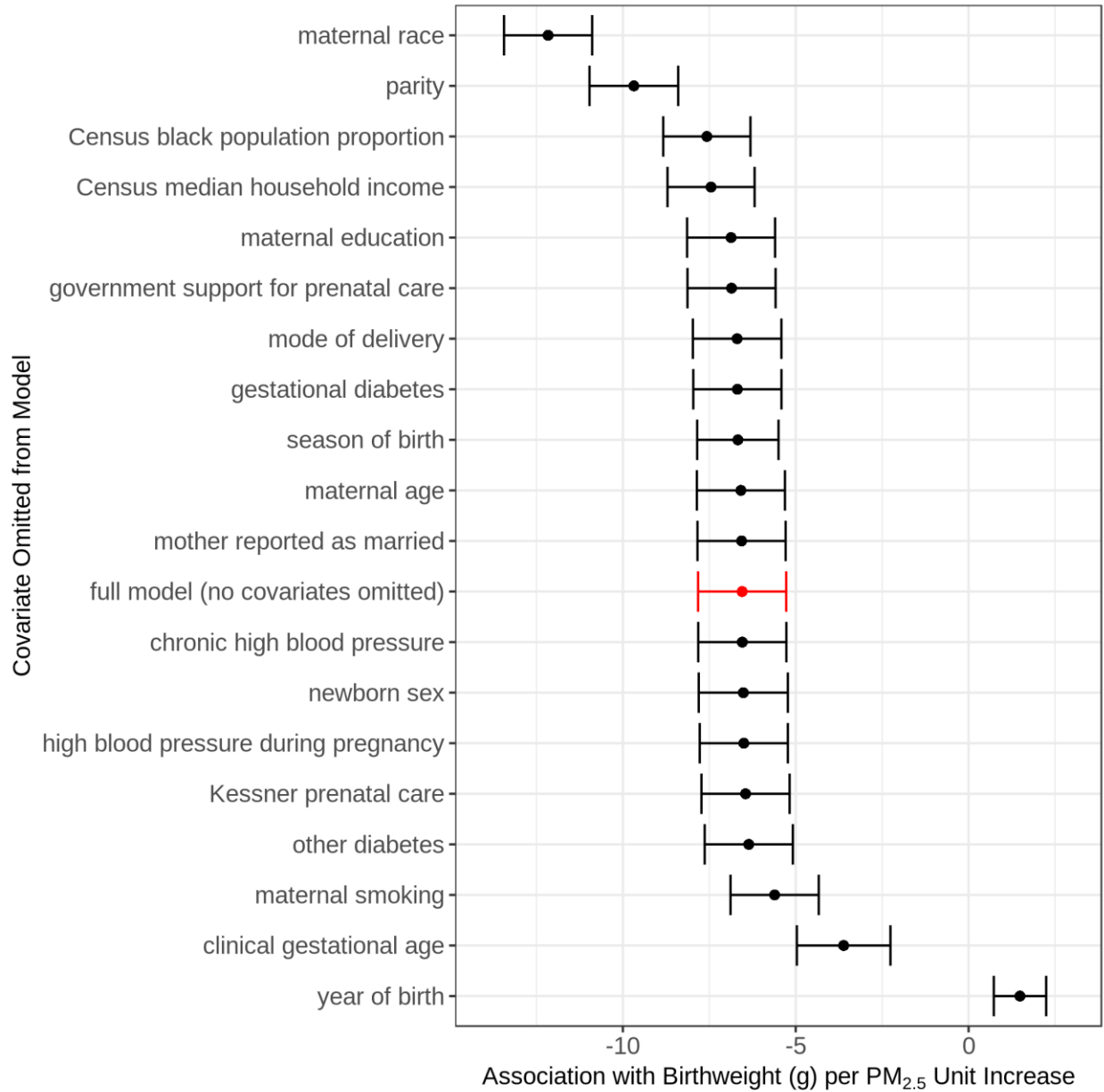


Figure S2:

Estimated effects on birthweight per 1 $\mu\text{g}/\text{m}^3$ increase in $\text{PM}_{2.5}$ constituents adjusted for total $\text{PM}_{2.5}$ in Massachusetts from 2001 to 2012. $\text{PM}_{2.5}$ constituents include elemental carbon (EC), organic carbon (OC), nitrate, and sulfate. Point estimate and 95% confidence interval per individual constituent are in purple while those for $\text{PM}_{2.5}$ are in teal. Four separate linear models for each of the four constituents were run and included adjustment for $\text{PM}_{2.5}$ and the following covariates: maternal age, race, marital status, smoking, education, parity, chronic diabetes, gestational diabetes, chronic high blood pressure, high blood pressure during pregnancy, Kessner index of adequacy of prenatal care, mode of delivery, clinical gestational age, year of birth, newborn sex, and Medicaid-supported prenatal care.

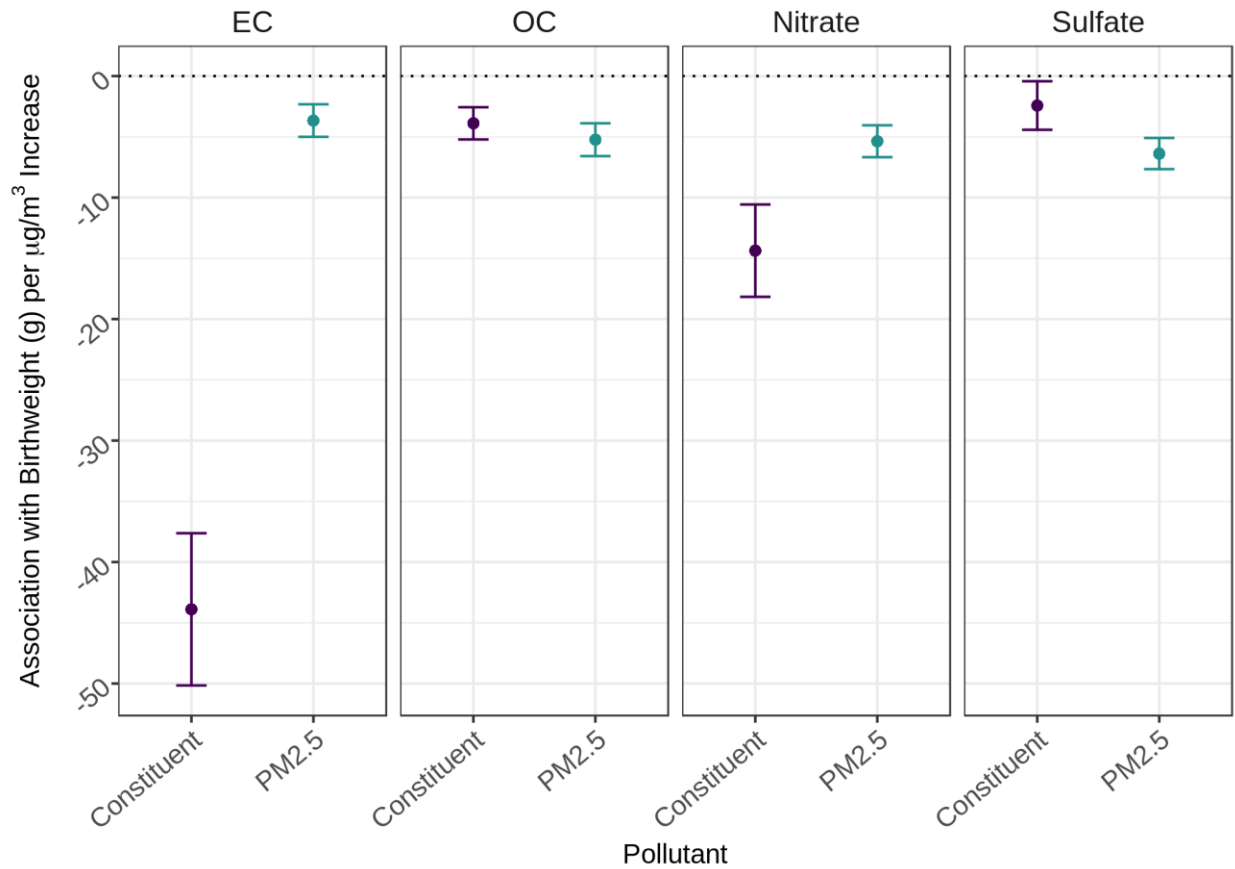


Figure S3:

Estimated effects on birthweight per 1 $\mu\text{g}/\text{m}^3$ increase in $\text{PM}_{2.5}$, EC, OC, Nitrate, and Sulfate in Massachusetts from 2001 to 2012. Point estimate and 95% confidence interval per individual constituent are in purple while that per $\text{PM}_{2.5}$ is in teal. A single multi-constituent linear regression with the four constituents and $\text{PM}_{2.5}$ was run and included the following covariates: maternal age, race, marital status, smoking, education, parity, chronic diabetes, gestational diabetes, chronic high blood pressure, high blood pressure during pregnancy, Kessner index of adequacy of prenatal care, mode of delivery, clinical gestational age, year of birth, newborn sex, and Medicaid-supported prenatal care.

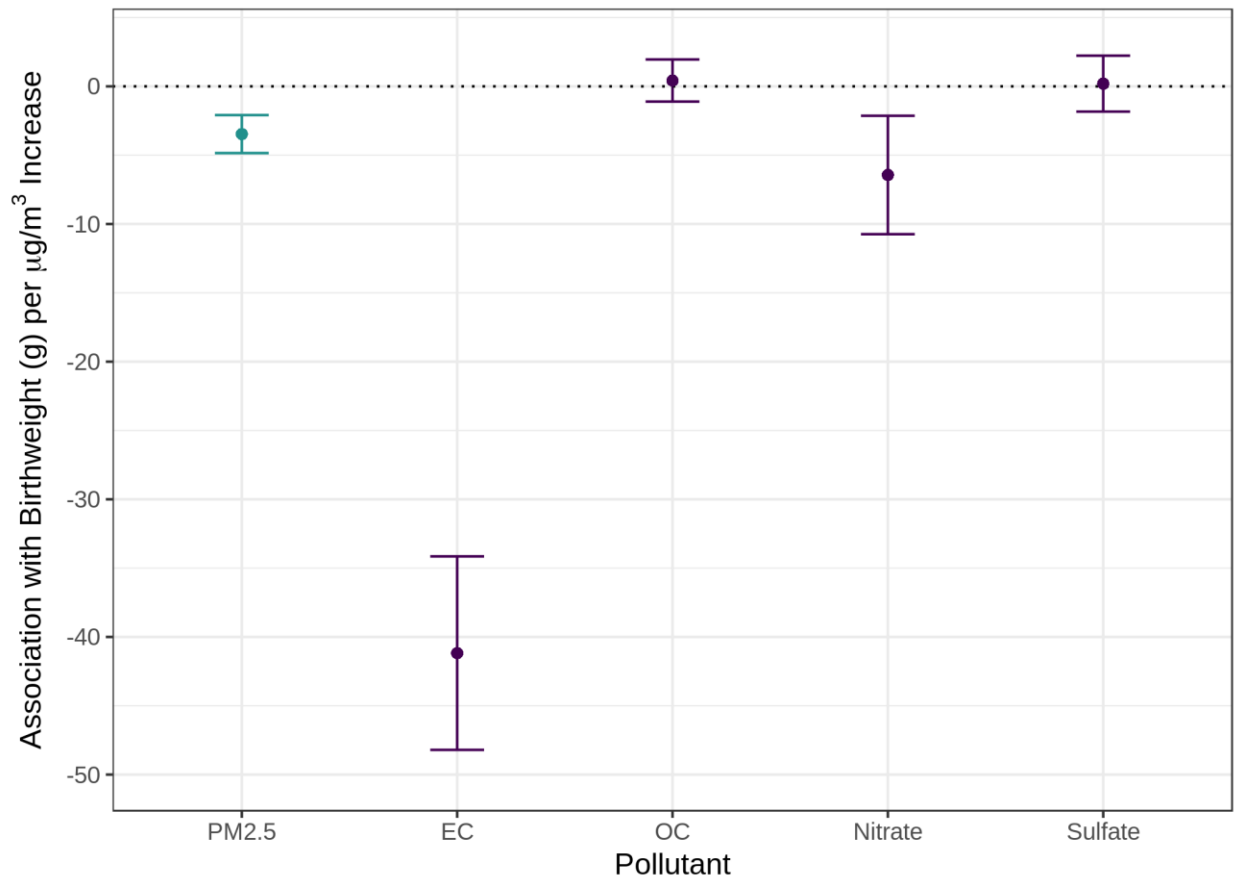


Figure S4:

Estimated Effects on Odds of Term Low Birth Weight (TLBW) per Interquartile Range (IQR) increase in PM_{2.5}, EC, OC, Nitrate, and Sulfate. PM_{2.5} constituents include elemental carbon (EC), organic carbon (OC), nitrate, and sulfate in Massachusetts from 2001 to 2012 (n = 725,919). Point estimate and 95% confidence interval per individual constituent are in purple while that per PM_{2.5} is in teal. A single multi-constituent linear regression with the four constituents and PM_{2.5} was run and included the following covariates: maternal age, race, marital status, smoking, education, parity, chronic diabetes, gestational diabetes, chronic high blood pressure, high blood pressure during pregnancy, Kessner index of adequacy of prenatal care, mode of delivery, clinical gestational age, year of birth, newborn sex, and Medicaid-supported prenatal care. IQRs (µg/m³): PM_{2.5} = 2.0, EC = 0.2, OC = 1.4, Nitrate = 0.5, Sulfate = 1.5.

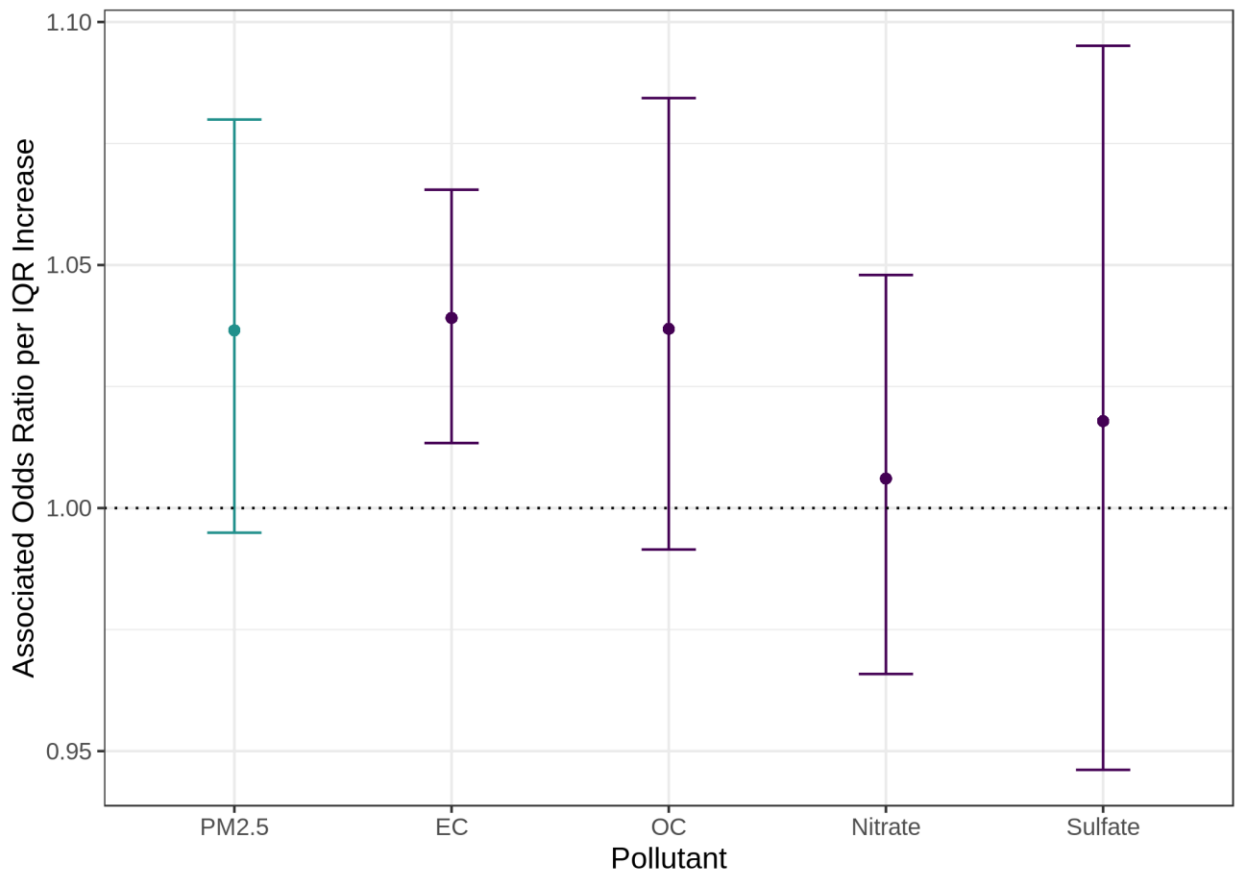


Figure S5:

Estimated Effects on Odds of Small for Gestational Age (SGA) per Interquartile Range (IQR) increase in PM_{2.5}, EC, OC, Nitrate, and Sulfate. PM_{2.5} constituents include elemental carbon (EC), organic carbon (OC), nitrate, and sulfate in Massachusetts from 2001 to 2012 (n = 725,919). Point estimate and 95% confidence interval per individual constituent are in purple while that per PM_{2.5} is in teal. A single multi-constituent linear regression with the four constituents and PM_{2.5} was run and included the following covariates: maternal age, race, marital status, smoking, education, parity, chronic diabetes, gestational diabetes, chronic high blood pressure, high blood pressure during pregnancy, Kessner index of adequacy of prenatal care, mode of delivery, clinical gestational age, year of birth, newborn sex, and Medicaid-supported prenatal care. IQRs (µg/m³): PM_{2.5} = 2.0, EC = 0.2, OC = 1.4, Nitrate = 0.5, Sulfate = 1.5.

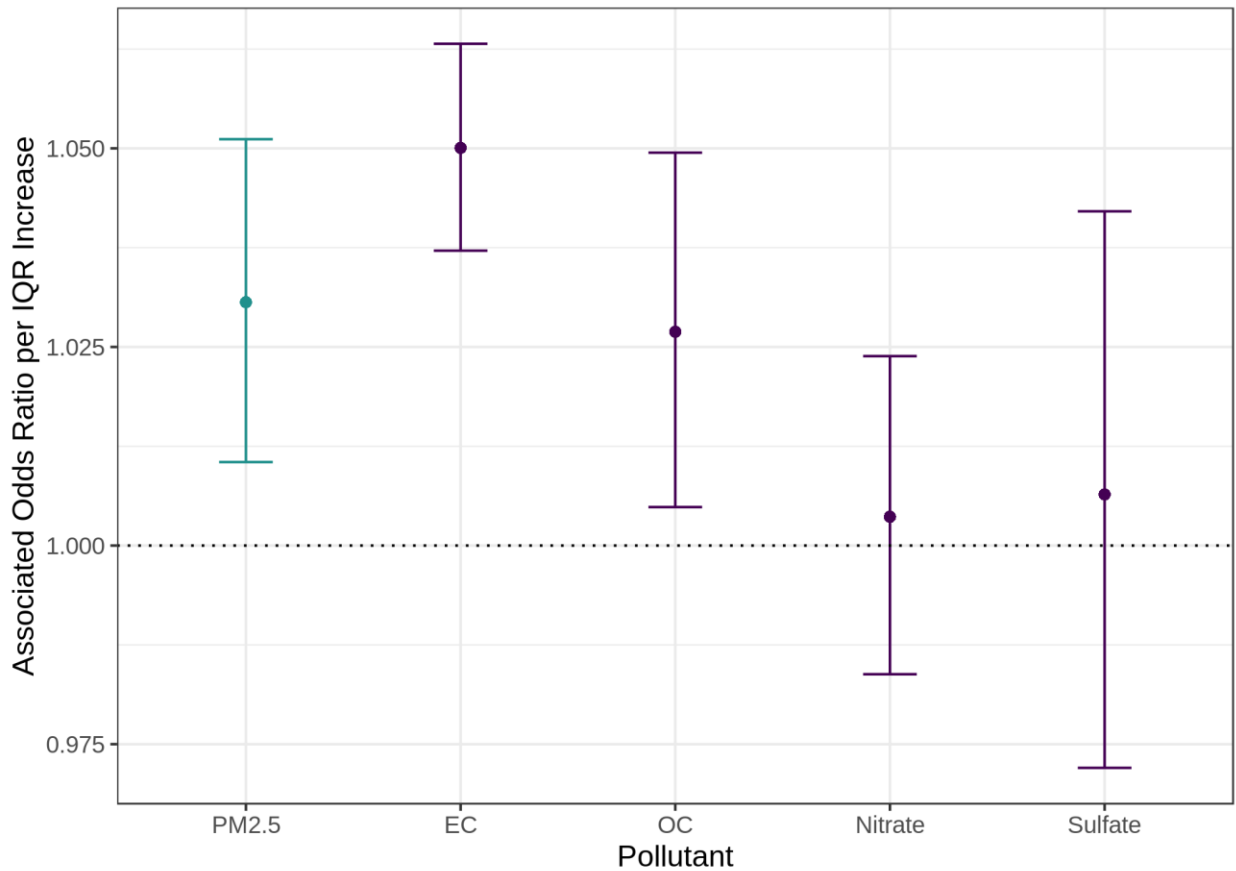


Figure S6:

Estimated Effects on Birthweight per Interquartile Range (IQR) increase in Third Trimester averaged exposure to a PM_{2.5} Constituent adjusted for PM_{2.5} in Massachusetts from 2001 to 2012 (n = 725,919). PM_{2.5} constituents include elemental carbon (EC), organic carbon (OC), nitrate, and sulfate. Point estimate and 95% confidence interval per individual constituent are in purple while those for PM_{2.5} are in teal. Four separate linear models for each of the four constituents were run and included adjustment for PM_{2.5} and the following covariates: maternal age, race, marital status, smoking, education, parity, chronic diabetes, gestational diabetes, chronic high blood pressure, high blood pressure during pregnancy, Kessner index of adequacy of prenatal care, mode of delivery, clinical gestational age, year of birth, newborn sex, and Medicaid-supported prenatal care.

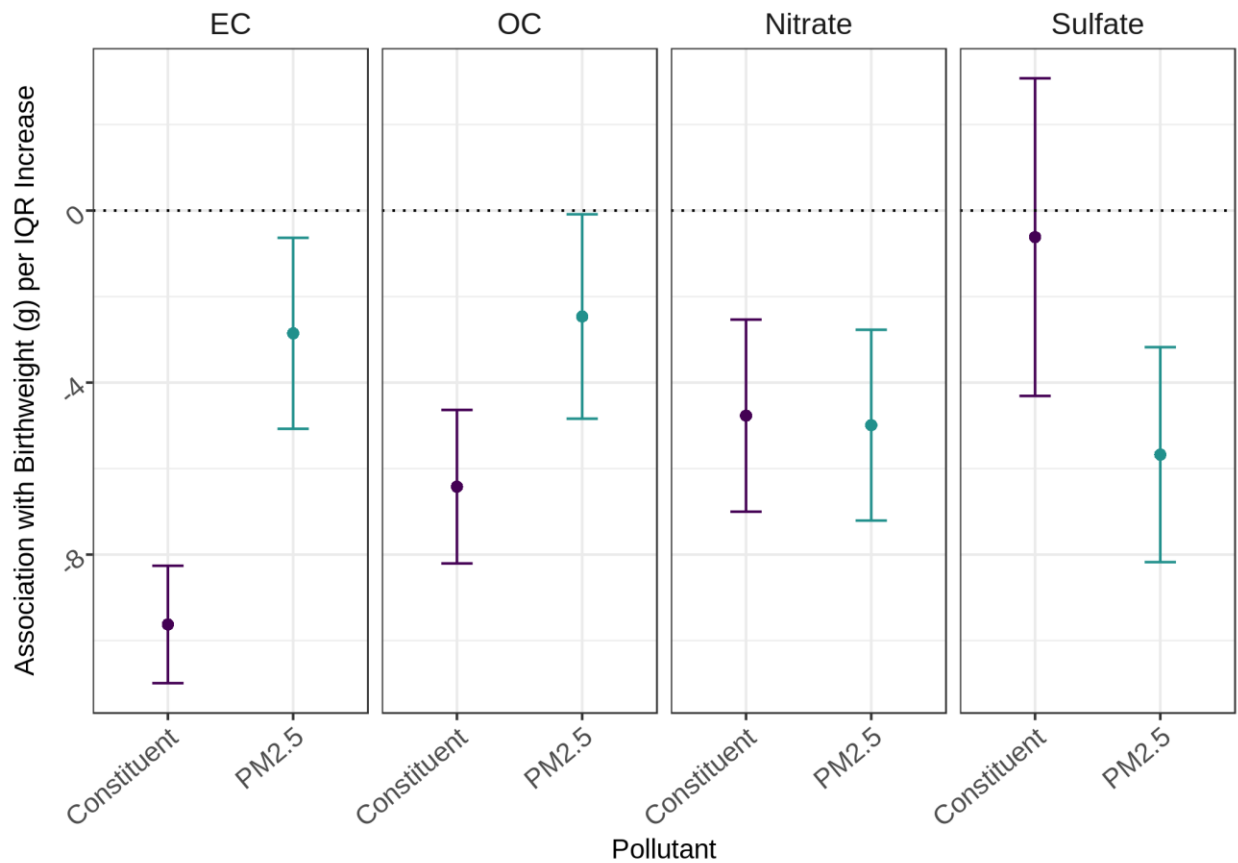


Figure S7:

Estimated Effects on Birthweight per Interquartile Range (IQR) increase in Third Trimester averaged exposure to PM_{2.5}, EC, OC, Nitrate, and Sulfate. PM_{2.5} constituents include elemental carbon (EC), organic carbon (OC), nitrate, and sulfate in Massachusetts from 2001 to 2012 (n = 725,919). Point estimate and 95% confidence interval per individual constituent are in purple while that per PM_{2.5} is in teal. A single multi-constituent linear regression with the four constituents and PM_{2.5} was run and included the following covariates: maternal age, race, marital status, smoking, education, parity, chronic diabetes, gestational diabetes, chronic high blood pressure, high blood pressure during pregnancy, Kessner index of adequacy of prenatal care, mode of delivery, clinical gestational age, year of birth, newborn sex, and Medicaid-supported prenatal care.

