

Exposure to Particulate Matter Air Pollution and Development of Hypertensive Disorders of Pregnancy

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Background

- Approximately 12-22% of pregnancies are complicated by hypertensive disorders, including preeclampsia and gestational hypertension.
- A few studies suggest that exposure to air pollution may be associated with development of these disorders

Methods

Study Population

- 1,973 pregnant women enrolled between 1999-2002
- Inclusion criteria: ability to speak English, singleton pregnancy, attended an initial visit before 22 weeks of gestation, and planned to reside in the Boston area throughout pregnancy

Exposure Assessment

- Hourly BC and PM_{2.5} concentrations measured at Harvard SuperSite
- Pollutants averaged into three month period prior to conception, first trimester, second trimester, third trimester, last month of pregnancy, and whole pregnancy

Outcome Assessment: Preeclampsia, Gestational Hypertension, and Preterm Birth

- Obtained from medical records

Statistical Methods

- Multivariable logistic regression models
- Pollutants treated as continuous linear
- Adjusted for age, season (harmonic), marital status, race, BMI, smoking, gestational diabetes, history of preeclampsia in a previous pregnancy, booking systolic blood pressure, personal education, median neighborhood household income, and neighborhood education

Results

Table 1: Participant Characteristics

Maternal Characteristics	Mean (SD) or No. (Percent) Case Status		p**
	No preeclampsia (n=1,904)	Preeclampsia (n=69)	
Age at enrollment (years)	31.9 (5.1)	31.1 (5.8)	0.25
Nulliparous	909 (48)	49 (71)	<0.001
White Race	1,293 (68)	37 (54)	0.047
Married	1,553 (82)	49 (71)	0.028
Pre-pregnancy BMI (kg/m ²)	24.7 (5.4)	28.5 (6.6)	<0.001
Smoking			0.13
Never	1,306 (69)	45 (65)	
Before pregnancy	362 (19)	10 (14)	
During pregnancy	236 (12)	14 (20)	
Diabetes			<0.001
None	1,570 (82)	45 (65)	
Transient hyperglycemia	165 (9)	6 (9)	
Impaired glucose tolerance	58 (3)	2 (4)	
Gestational diabetes	98 (5)	13 (19)	
Prepregnancy diabetes	13 (0.7)	2 (3)	
Preeclampsia in prior pregnancy	57 (3)	5 (7)	0.37
Booking systolic blood pressure (mmHg)	112 (10.3)	116 (11.4)	<0.001
Distance to major roadway (m)	1,666 (1,863)	1,681 (1,904)	0.95
Some College or Higher	1,675 (88)	57 (83)	0.18
Neighborhood education*	13.7 (10.0)	16.6 (12.5)	0.02
Median household income (Yr2000\$)	56,884 (21,123)	52,790 (19,991)	0.11
Preterm birth	112 (6)	18 (26)	<0.001

*Neighborhood education is the mean percentage of census tract residents age ≥25 without a high school diploma.

**P value is from ANOVA for continuous variables and χ^2 or Fisher exact test for categorical variables.

Table 2: Pollutant Characteristics

Period	Pollutant*	Mean	SD	IQR
3 Mo. Pre-Conception	BC	0.88	0.12	0.16
	PM _{2.5}	10.9	1.5	2.4
1st Trimester	BC	0.87	0.11	0.15
	PM _{2.5}	10.9	1.5	2.2
2nd Trimester	BC	0.85	0.11	0.16
	PM _{2.5}	11.0	1.4	1.7
Month Prior to Delivery	BC	0.84	0.15	0.21
	PM _{2.5}	11.2	2.5	2.5
Full Pregnancy	BC	0.85	0.05	0.06
	PM _{2.5}	11.0	0.92	1.7

SD: standard deviation, IQR: interquartile range

*Units are $\mu\text{g}/\text{m}^3$

Table 3: ORs per IQR Increase in BC and PM_{2.5}

Outcome	Period	BC (95% CI)	PM _{2.5} (95% CI)
Preeclampsia	3 Mo. Pre-Conception	0.74 (0.43, 1.26)	0.61 (0.39, 0.96)
	1 st Trimester	1.43 (0.82, 2.53)	1.20 (0.81, 1.78)
	2 nd Trimester	0.87 (0.43, 1.76)	0.79 (0.58, 1.08)
	Last Month	1.10 (0.69, 1.77)	1.00 (0.76, 1.32)
Gestational Hypertension	Full Pregnancy	1.29 (0.80, 2.08)	0.97 (0.62, 1.53)
	3 Mo. Pre-Conception	1.43 (0.99, 2.05)	1.06 (0.77, 1.45)
	1 st Trimester	0.82 (0.54, 1.26)	0.67 (0.49, 0.90)
	2 nd Trimester	1.30 (0.77, 2.21)	0.90 (0.71, 1.13)
Preterm Birth	Last Month	1.02 (0.72, 1.45)	1.09 (0.90, 1.31)
	Full Pregnancy	1.00 (0.70, 1.43)	0.72 (0.51, 1.02)
	3 Mo. Pre-Conception	1.24 (0.87, 1.77)	0.78 (0.57, 1.07)
	1 st Trimester	1.11 (0.73, 1.68)	0.95 (0.71, 1.26)
	2 nd Trimester	1.01 (0.61, 1.67)	0.93 (0.75, 1.17)
	Last Month	1.31 (0.93, 1.84)	0.88 (0.71, 1.08)
	Full Pregnancy	1.34 (0.93, 1.92)	0.81 (0.58, 1.13)

Conclusions

- No associations between pollutant exposure and outcomes
- No prior studies on BC, but other studies have shown associations with PM
- Differences in exposure assessment, study populations may explain differing results
- Further studies will use spatio-temporal models of pollution exposure

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