



Association of Environmental Air Quality and Congenital Heart Defect Diagnosis

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INTRODUCTION

- Congenital heart defects (CHD) are the most common birth defect impacting 34.4 million people globally
- 80% of CHD diagnosis have unknown etiology
- Environmental risk factors are thought to play an important piece in the development of a CHD
- Air pollution is a major environmental risk factor impacting health, including mortality, morbidity, and has links to asthma, heart disease, and birth defects
- Particulate Matter 2.5 (PM_{2.5}) and Ozone (O₃) are commonly monitored air pollutants considered harmful to the environment and the public's health
- Epidemiologic research supporting the environmental risk for a CHD diagnosis is limited, often displaying conflicting results

Purpose

- Identify the relationship between air quality and the odds of infants diagnosed with a critical CHD in the first year of life

METHODOLOGY

- Cases obtained from local hospital database and STS database
- Total of 199 cases met inclusion criteria:
 - Diagnosed with 1 of 13 critical CHD within 1 year of age
 - Born to mother with MS residence
 - Born between Jan 1, 2014 – Dec 31, 2016
- Controls obtained from vital statistics database (n=99,706)
- Air pollutant data obtained from air monitoring stations throughout MS and bordering states (n=26 for PM_{2.5}; n=34 for O₃)
- Geographical information systems (GIS) used to geocode residential address and interpolate individual air pollutant exposure during:
 - First trimester of pregnancy (week 1-12)
 - Critical exposure window of fetal heart development (week 3-8)
- Bivariate logistic regression models were conducted

RESULTS

Characteristic	Week 3-8 Gestation Average (n=663)			Week 1-12 Gestation Average (n=663)		
	aOR	95% CI	p-value	aOR	95% CI	p-value
PM_{2.5}						
Race			.010			.007
Black	1.00	referent		1.00	referent	
White	1.663	[1.058, 2.615]		1.688	[1.070, 2.662]	
Other	3.188	[1.377, 7.380]		3.417	[1.472, 7.936]	
Gender			.108			.094
Male	1.00	referent		1.00	referent	
Female	0.709	[0.466, 1.078]		0.699	[0.459, 1.063]	
Distance from Monitor			.063			.064
<10km	1.00	referent		1.00	referent	
10.1-50km	0.666	[0.434, 1.022]		0.666	[0.434, 1.023]	
PM_{2.5} Level (µg/m³)			.146			.105
<5.7	1.00	referent		1.00	referent	
5.71-7.9	1.236	[0.148, 10.324]		0.345	[0.033, 3.575]	
7.91-10.6	1.976	[0.243, 16.064]		0.543	[0.055, 5.375]	
>10.61	2.410	[0.292, 19.887]		0.793	[0.078, 8.025]	

- Limited to maternal residence 50 km boundary around air monitoring stations
- Cases included 115 infants eligible for PM_{2.5} analysis and 109 eligible for O₃ analysis
- Controls consisted of 550 randomly selected infants from the control sample to provide 1:5 ratio

O₃ analysis

- Distance from pollutant monitor was statistically significant showing a 46% decrease odds of a critical CHD diagnosis when living 10-50 km away

PM_{2.5} analysis

- Race variable was statistically significant with infants who were non-white and non-black 3 times more likely to obtain critical CHD diagnosis
- As PM_{2.5} level increased, the odds of a critical CHD diagnosis increased
 - Also supported in further analysis during week 5 and week 8-12
- Although not significant, decreased odds were identified in all weeks when infants lived 10 to 50 km away from pollutant monitoring station

Characteristic	Week 3-8 Gestation Average (n=420)			Week 1-12 Gestation Average (n=349)		
	aOR	95% CI	p-value	aOR	95% CI	p-value
O₃						
Race			.842			.836
Black	1.00	referent		1.00	referent	
White	1.171	[0.672, 2.043]		1.205	[0.652, 2.228]	
Other	1.224	[0.323, 4.638]		1.048	[0.215, 5.094]	
Gender			.952			.866
Male	1.00	referent		1.00	referent	
Female	1.016	[0.598, 1.726]		0.950	[0.527, 1.715]	
Distance from Monitor			.026			.053
<10km	1.00	referent		1.00	referent	
10.1-50km	0.541	[0.314, 0.930]		0.543	[0.293, 1.008]	
O₃ Level (ppm)			.412			.127
<0.0290	1.00	referent		1.00	referent	
0.0291-0.0370	1.402	[0.476, 4.128]		1.459	[0.454, 4.693]	
0.0371-0.0450	0.897	[0.316, 2.549]		0.641	[0.218, 1.887]	
>0.0451	1.476	[0.438, 4.514]		1.227	[0.341, 4.413]	

Adjusted odds ratios (aOR) and 95% Confidence Intervals (CI) for diagnosis of a critical CHD when exposed to PM_{2.5} and O₃

CONCLUSION

- No model supported a statistically significant relationship between PM_{2.5} or O₃ levels and a critical CHD diagnosis
- Significance was noted between pollutants and covariates – race and distance from monitoring station
- In the state of MS, air pollution levels were lower than EPA set standard
 - Mean for PM_{2.5} was 8.69 µg/m³ (EPA was 12 µg/m³)
 - Mean for O₃ was 0.038 ppm (EPA was 0.07 ppm)
- However even a small amount of air pollution may carry a large health impact
- Further research on individual critical and non-critical CHDs is warranted

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