

The association between low birth weight and particulate matter 2.5 using community multiscale air quality modeling system : APPO(air pollution on pregnant women) study

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Objective

To evaluate the effect of particulate matter 2.5 during pregnancy on the birth weight of newborns

Methods

This study was a retrospective cohort study of 1849 pregnant women who delivered at Ewha Womans University Mokdong hospital between 2010 to 2015. Level of PM_{2.5} exposures were measured based on the Community Multiscale Air Quality (CMAQ) Modeling System. PM_{2.5} level from CMAQ modelling data was estimated using meteorological research and forecasting models comprising three overlapping weather data sources at 3,9, and 27 km for a specific time period of time. We stratified by birth weight and performed using Student t-test. P value <0.05 was considered statistically significant.

Results

The average PM_{2.5} concentration of the study subjects was 28.61, 28.64, 26.38, and 26.49ug/m³ in the pre trimester, first trimester, second trimester, and third trimester, respectively(Table 1). Among the delivery neonates, there were 1,567 of normal birth weight babies and 282 of low-weight babies. The PM 2.5 concentration of second trimester of pregnancy from women who delivered low birth weight (LBW) babies was 27.21ug/m³, which was significantly higher than that of 26.23ug/m³ from women who delivered normal birth weight (NBW) group (P=0.02)(Table 2). When the neonates were divided into term and preterm birth group, the concentrations of PM 2.5 in first and second trimesters of LBW infants in PTB group were 27.58 and 27.25 ug/m³, which were significantly higher than the concentrations of 25.81 and 25.57 ug/m³, which are NBW babies, respectively (P=0.046, 0.04)(Table 3).

Table 1. Summary of PM_{2.5} concentration (ug/m³) by each trimester of pregnancy

Stage	N	Mean	SD	Min	25 th	50 th	75 th	Max
Entire	1849	27.21	4.36	16.02	23.33	27.83	30.64	42.61
Pre trimester	1849	28.61	7.64	13.37	22.70	27.49	34.73	54.06
1 st trimester	1849	28.64	7.64	13.03	21.88	27.32	35.82	50.91
2 nd trimester	1849	26.38	6.75	13.49	20.77	26.14	32.22	44.74
3 rd trimester	1849	26.49	6.80	9.35	21.78	25.93	31.22	90.58

Table 2. Comparison of PM_{2.5} exposure(ug/m³) by each trimester in the normal birth weight (NBW) and low birth weight (LBW) according to sex

Stage	All newborns					Boys					Girls				
	NBW		LBW		P	NBW		LBW		P	NBW		LBW		P
N	Mean (SD)	N	Mean (SD)	N		Mean (SD)	N	Mean (SD)	N		Mean (SD)	N	Mean (SD)	N	
Entire	1567	27.17 ± 4.30	282	27.40 ± 4.67	0.43	792	27.24 ± 4.37	149	27.79 ± 4.82	0.17	773	27.11 ± 4.24	132	26.93 ± 4.48	0.65
Pre trimester	1567	28.69 ± 7.58	282	28.14 ± 8.00	0.26	792	28.95 ± 7.56	149	28.04 ± 8.42	0.18	773	28.41 ± 7.59	132	28.27 ± 7.55	0.84
1 st trimester	1567	28.75 ± 7.63	282	28.04 ± 7.70	0.15	792	28.91 ± 7.87	149	28.38 ± 7.94	0.45	773	28.59 ± 7.38	132	27.71 ± 7.42	0.21
2 nd trimester	1567	26.23 ± 6.78	282	27.21 ± 6.53	0.02*	792	26.26 ± 6.70	149	27.89 ± 6.79	0.01*	773	26.22 ± 6.86	132	26.38 ± 6.15	0.78
3 rd trimester	1567	26.40 ± 6.43	282	27.04 ± 8.56	0.23	792	26.39 ± 6.28	149	26.94 ± 8.63	0.46	773	26.38 ± 6.57	132	27.03 ± 8.40	0.40

Table 3. Subgroup analysis of comparison of PM_{2.5} exposure (ug/m³) by each trimester in the normal birth weight (PNBW) and low birth weight (PLBW) at preterm

Stage	All newborns					Boys					Girls				
	PNBW		PLBW		P	PNBW		PLBW		P	PNBW		PLBW		P
N	Mean (SD)	N	Mean (SD)	N		Mean (SD)	N	Mean (SD)	N		Mean (SD)	N	Mean (SD)	N	
Entire	84	25.89 ± 4.15	231	27.29 ± 4.78	0.02*	48	25.06 ± 4.03	126	27.61 ± 4.90	0.002*	36	27.00 ± 4.10	104	26.87 ± 4.64	0.88
Pre trimester	84	27.44 ± 8.07	231	27.85 ± 7.88	0.69	48	26.57 ± 8.17	126	27.60 ± 8.18	0.46	36	28.59 ± 7.90	104	28.17 ± 7.58	0.77
1 st trimester	84	25.81 ± 6.63	231	27.58 ± 7.57	0.046*	48	24.35 ± 6.21	126	27.73 ± 7.65	0.003*	36	27.77 ± 6.76	104	27.48 ± 7.50	0.84
2 nd trimester	84	25.57 ± 6.26	231	27.25 ± 6.58	0.04*	48	24.82 ± 5.87	126	27.81 ± 6.82	0.01*	36	26.58 ± 6.69	104	26.51 ± 6.22	0.95
3 rd trimester	84	26.69 ± 6.15	231	27.23 ± 8.98	0.55	48	26.92 ± 5.61	126	27.27 ± 9.09	0.80	36	26.39 ± 6.86	104	27.02 ± 8.77	0.66

Conclusion

This study shows that there is a significant association between low birth weight and PM 2.5 and PTB group is more susceptible to PM_{2.5} exposure. Also, this study implies boys are particularly vulnerable to PM 2.5 exposure. Furthermore, this study suggests that pregnant women who are more likely to have low birth weight babies may need to take precautions to avoid exposure to PM 2.5 in the first and second trimester of pregnancy.