Ko-CHENS!
어린이환경보건출생코호트
Korean CHildren's ENvironmental health Study

2015.10.25

Air pollution and pregnancy outcome and children's health

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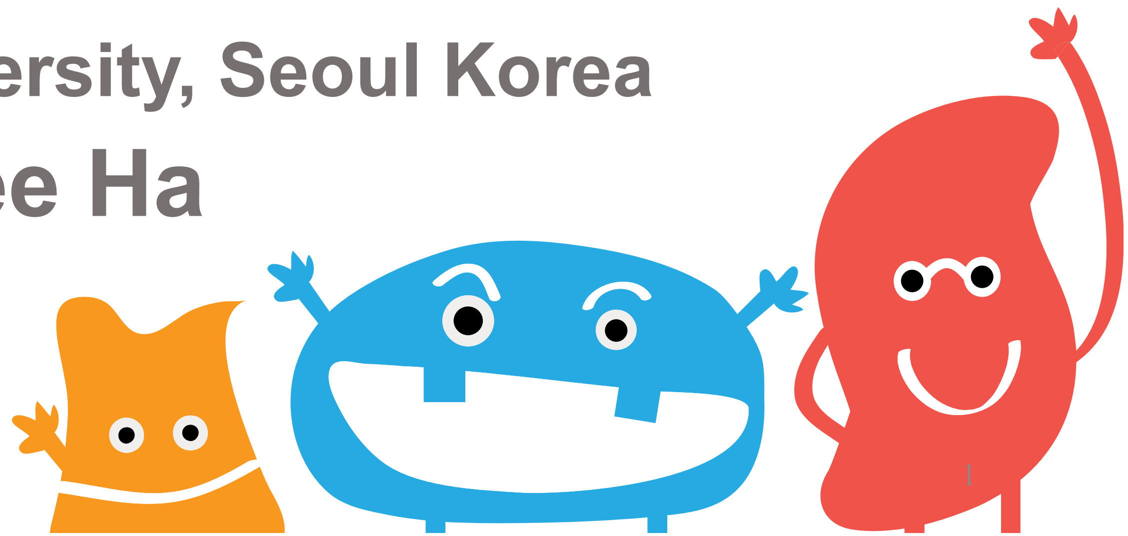

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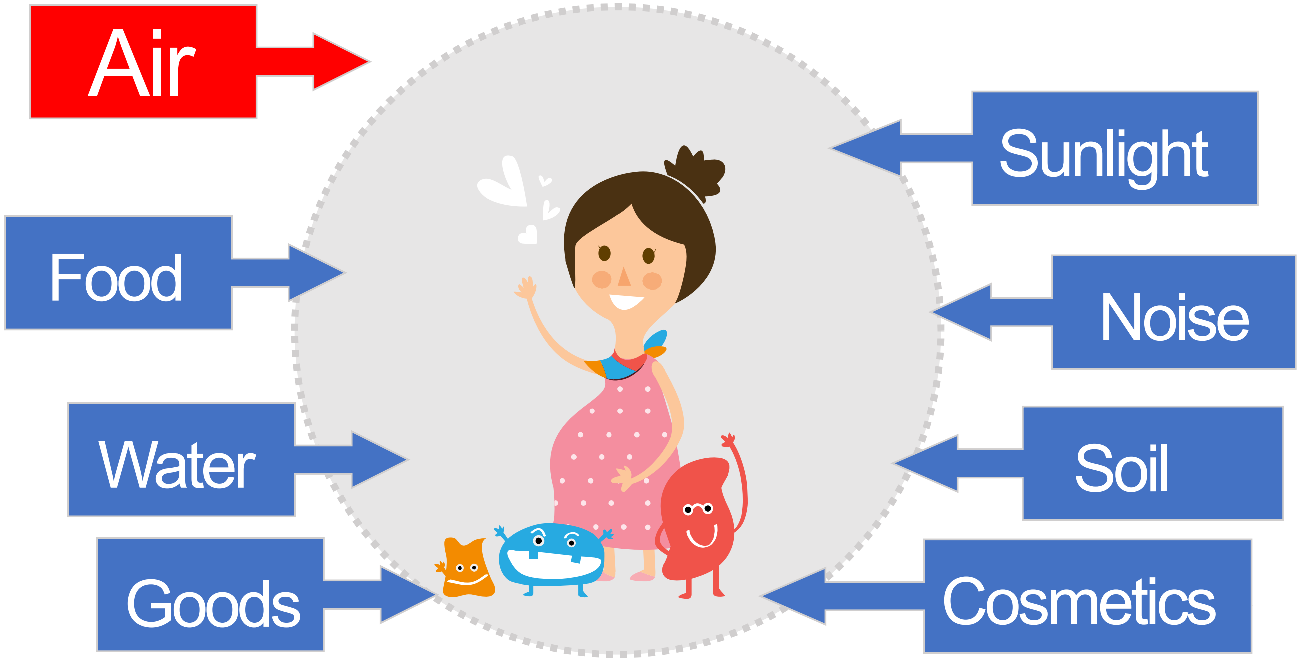
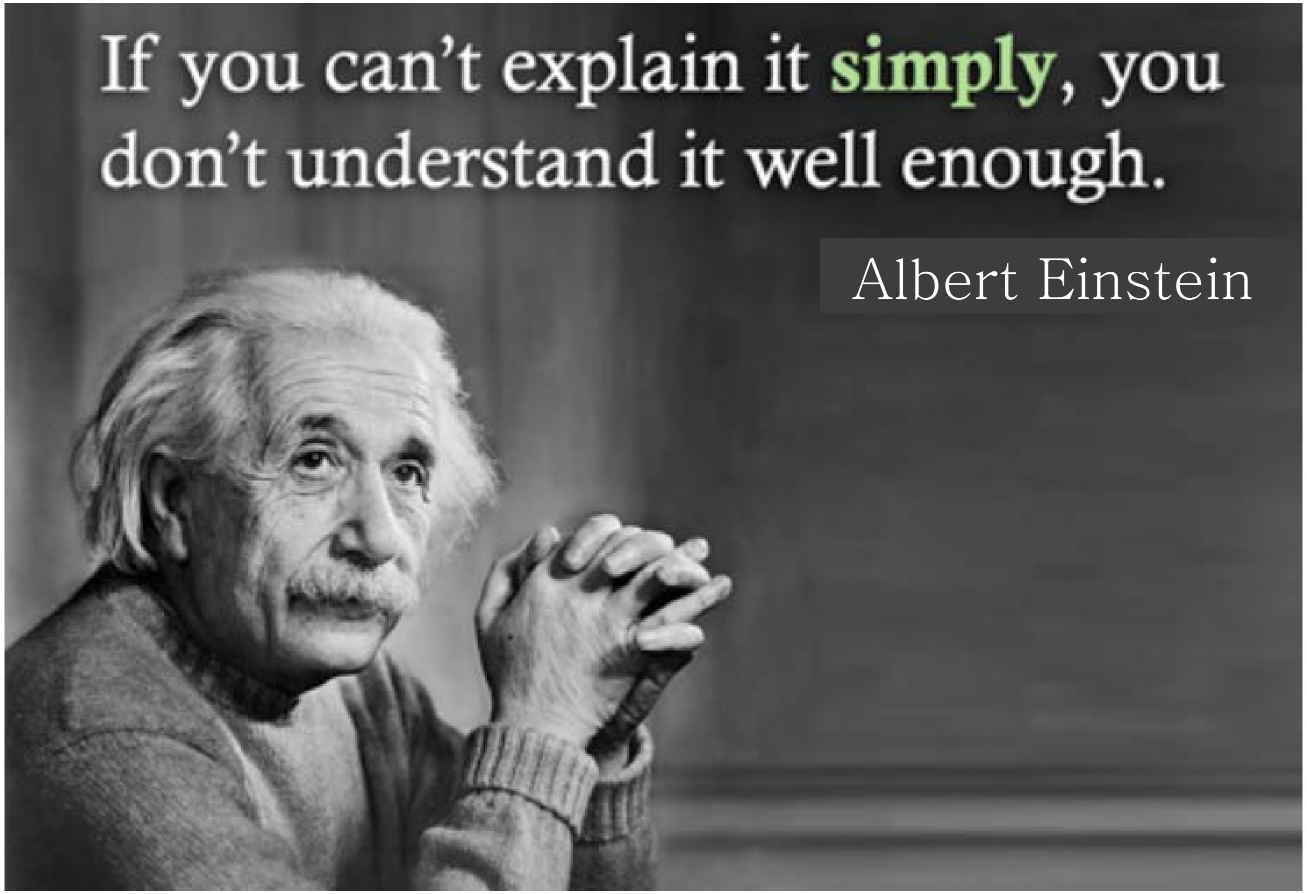
I. Environmental pollutants



1. what is the environment?

"The environment is everything that is not me" **Albert Einstein**

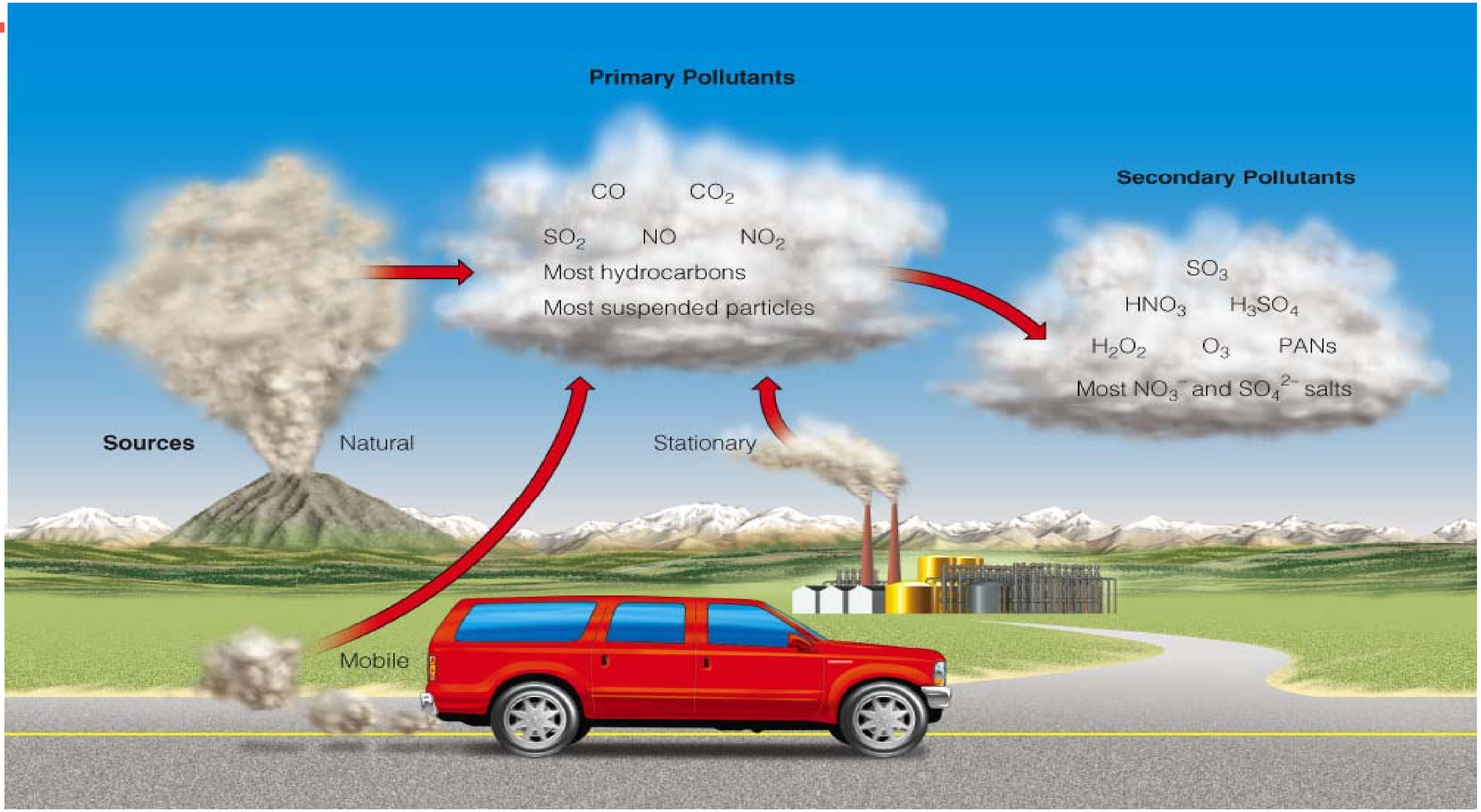


2. Environmental pollutant is..

- Focuses on exposure to contaminants found in the environment(specifically during critical periods of development)
- All the physical, chemical, biological and social factors that may affect the origin, growth, development and survival of an organism in a given setting.
- *Some examples include:*
  - Air contaminants
  - Specific synthetic chemicals
  - Some metals

Still an emerging issue!

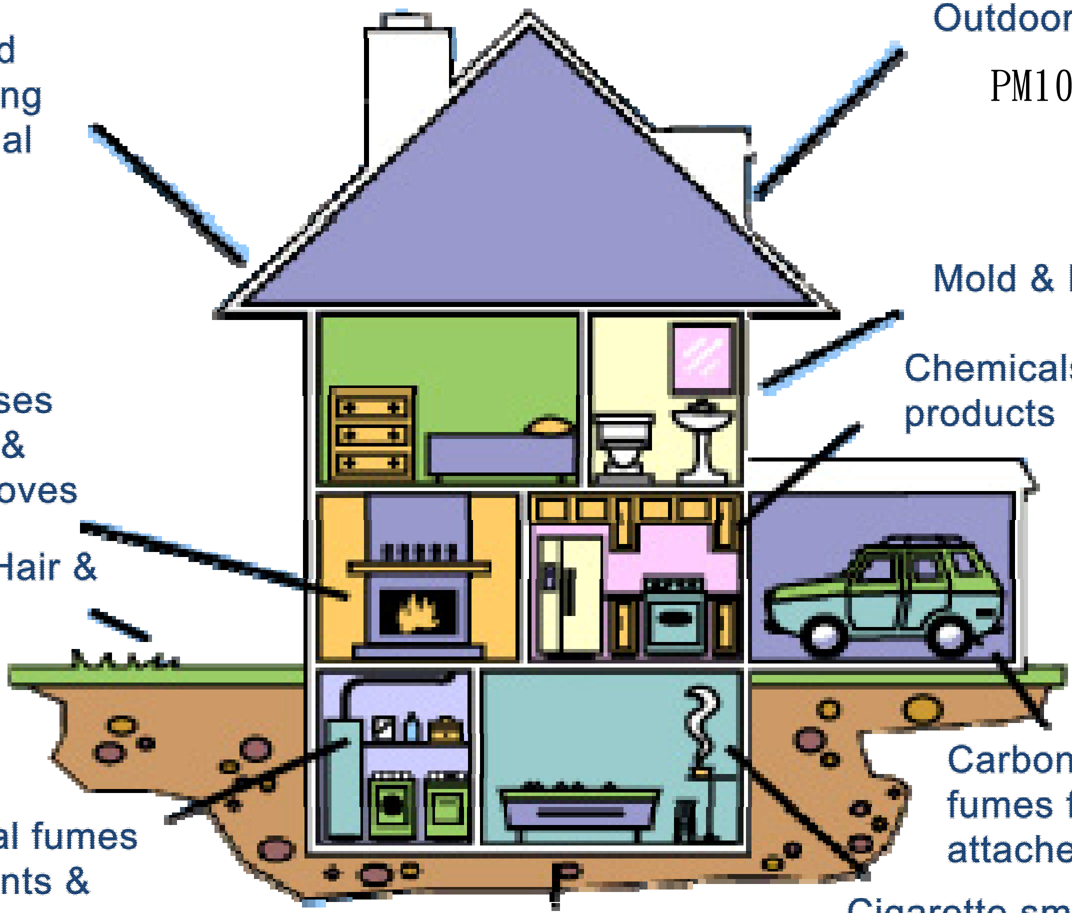
3. Ambient(outdoor) air pollutant is…



Some primary air pollutants may react with one another or with other chemicals in the air to form secondary air pollutants.

- A 2013 assessment by WHO's International Agency for Research on Cancer (IARC) concluded that outdoor air pollution is carcinogenic to humans, with the particulate matter component of air pollution most closely associated with increased cancer incidence, especially cancer of the lung.

4. Indoor air pollutant's source is…

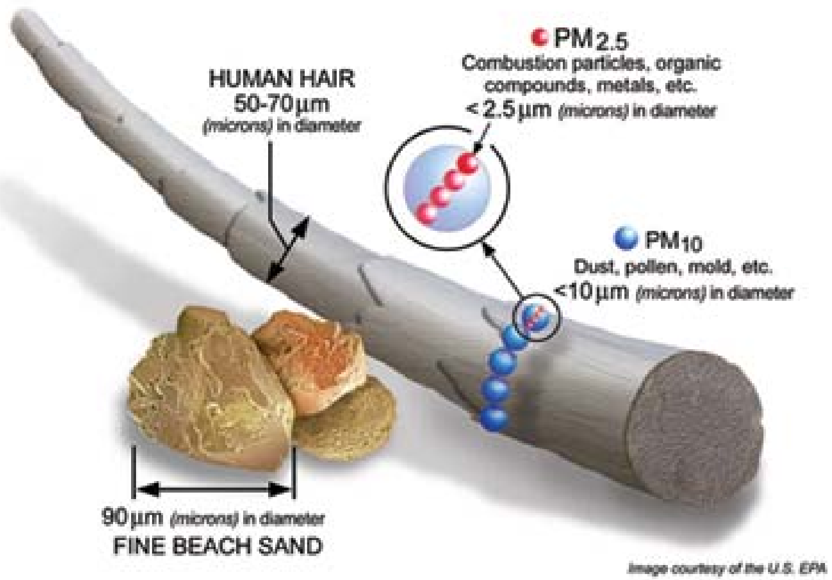


Source: Reprinted from US Environmental protection Agency. Air Pollution Control Orientation Course, Indoor Air Pollution. Available at: http://www.epa.gov/air/oaqps/eog/course422/ap4.html. Accessed March 22,2010

5. Key air pollutants

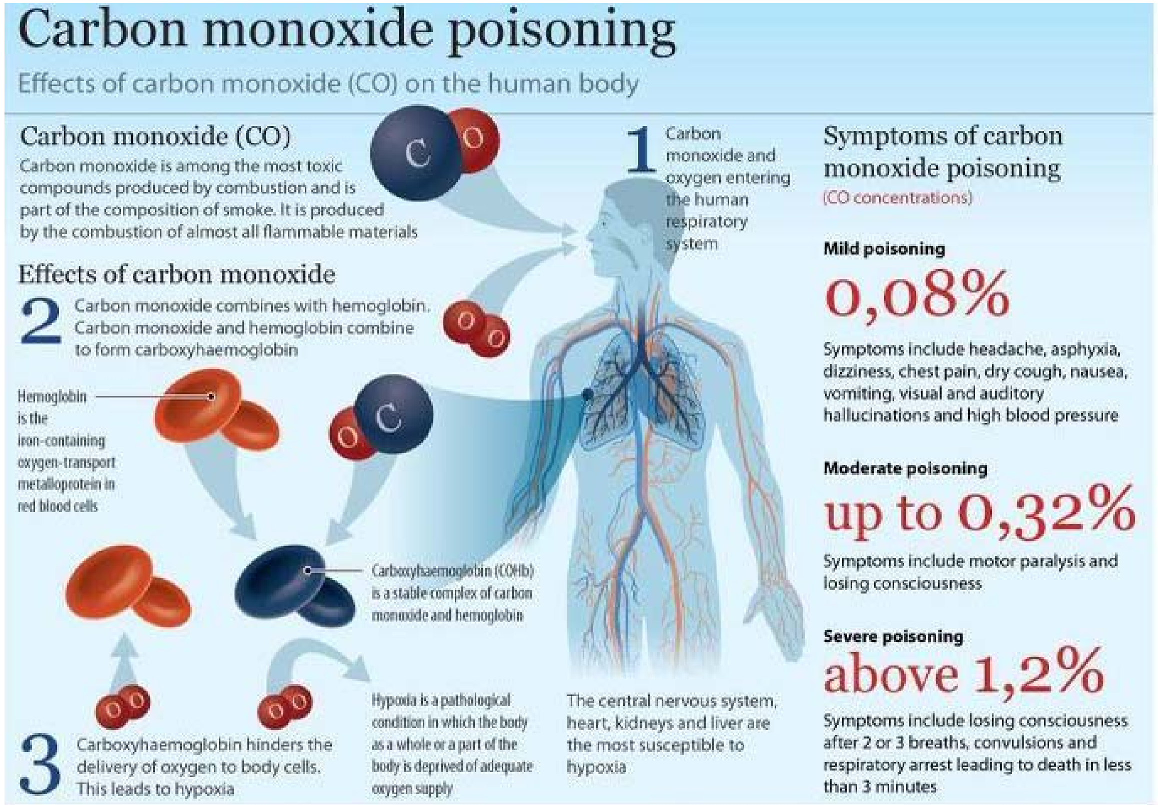
1) Particulate Matter

- Particulate matter (PM) is an air pollution term for a mixture of solid particles and liquid droplets found in the air.
- Of particular concern is a class of particles known as fine particulate matter or PM2.5 that gets deep into the lung
- Particles that are small enough to be inhaled have the potential to cause health effects.
- Children frequently breathe through their mouths, thus bypassing the nasal filtration mechanism



2) Carbon Monoxide

- Incomplete combustion of biomass fuel/ poorly maintained or poorly ventilated cooking or heating appliances
- The binding of CO to hemoglobin: 245 times as strong as that for oxygen
- Bain tissue metabolism is maintained until carboxyhemoglobin approaches 20%.



Guidelines

100mg/m^3 for 15 mins ; 35mg/m^3 for 1 hr ; 10 mg/m^3 for 8hrs ; 7mg/m^3 for 24 hrs

3) Polycyclic Aromatic Hydrocarbons

- A large group of organic compounds with two or more fused aromatic (benzene) rings
- Particle-bound PAHs (multiringed) are considered to be very harzardous to human health

Benzo[a]pyrene(B[a]P)

✓ As a marker for carcinogenic PAHs as the contribution of B[a]P to the total carcinogenic potential is high

✓ Buring of fossil fuels and biofuels for cooking in unvented stove (gas< kerosene<coal<wood<dung cake/wood mixture<dung cake)

✓ Human effects

Their mutagenicity and carcinogenicity by the formation of DNA adducts ▸ Immunotoxic, decrease fertility, embryotoxicity, reduction in birth weight, increased the risk of asthma symptoms by the age of 1-2 years

4) Nitrogen Dioxide and Sulphur Dioxide

- Indoor sources of NO_2 Tobacco smoke, burning appliances such as stoves, ovens, heaters, fireplace
- NO_2 is a free radical and it has the potential to deplete tissue antioxidant defenses and cause injury and inflammation
- Indoor level of NO_2 are from both indoor and outdoor sources
- The association of lower respiratory symptoms with indoor NO_2 in children from the Six Cities study and respiratory illness from meta-analysis in 1990s
- Similar respiratory health effect observed with increasing SO_2

5) VOCs AND Formaldehyde

- **Volatile organic compounds** (VOCs) are organic chemicals that have a high vapor pressure at ordinary room temperature

- cleaning, painting, or hobby supplies that contain them

- dry clean your clothes with home dry-cleaning products; at a professional dry-cleaners;

- graphics and crafts materials such as glues, permanent markers, and photographic solutions

- **Formaldehyde** is a naturally-occurring organic compound with the formula CH_2O.

- Exposed at home if you use unvented.

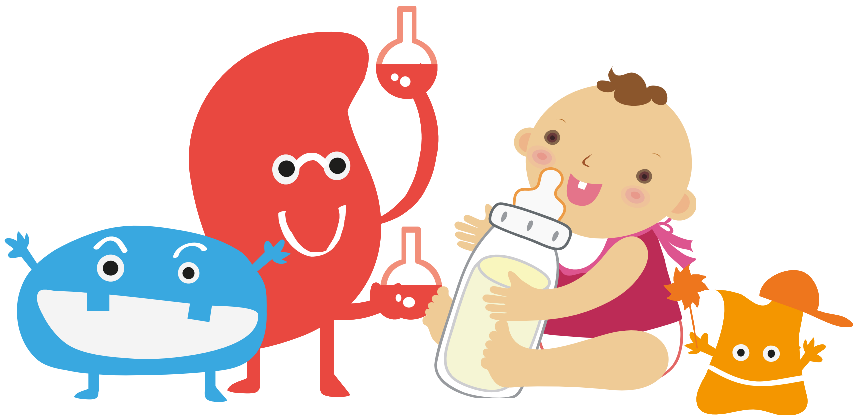
- by using household products such as construction materials, latex paints, fingernail polish, cosmetics, disinfectants, glues, lacquers, manufactured pressed wood products, fiberglass, new carpets, permanent press fabrics, paper products, and some cleaners.

II. Children and Environment
:Why children are important?

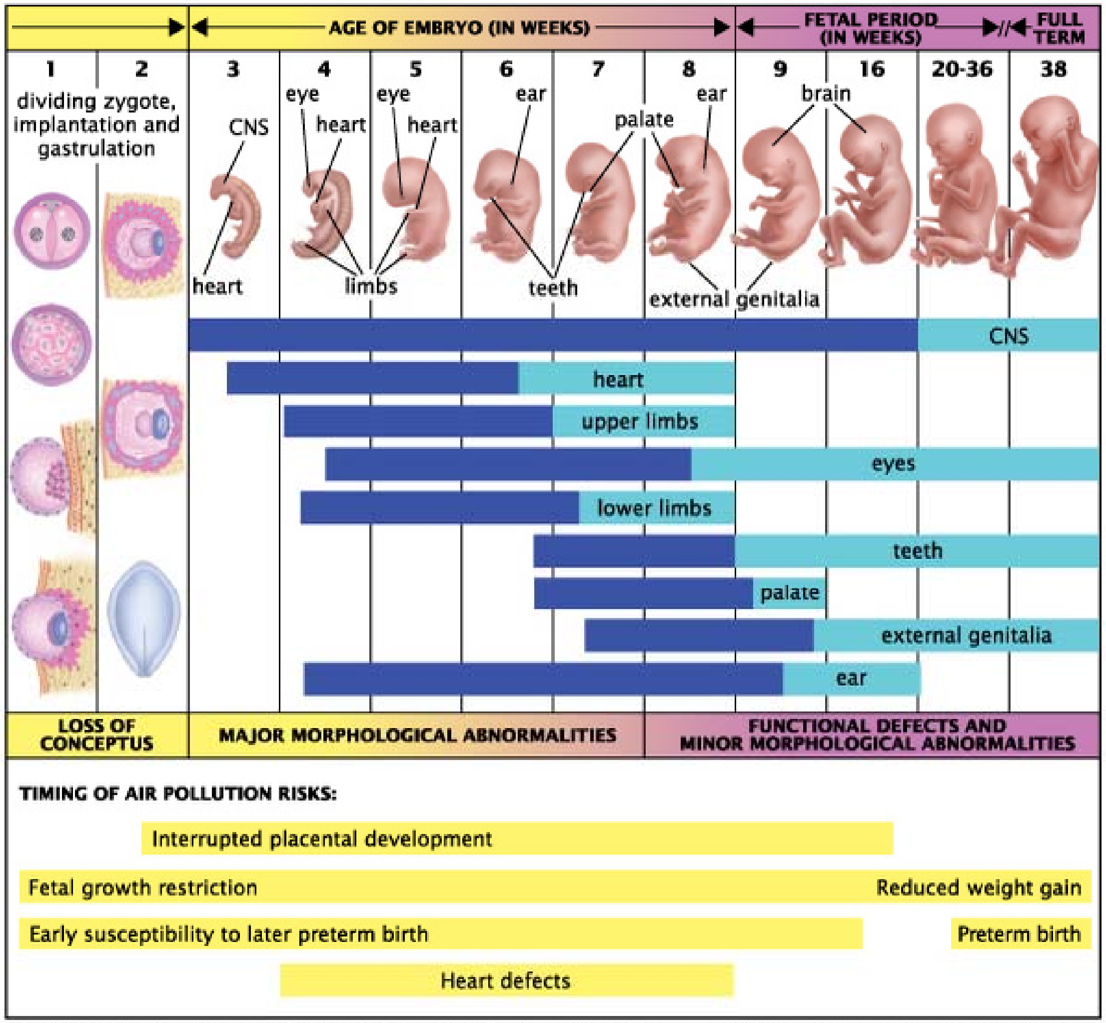
1. Children are not “little adults”

- Exposures to toxic chemicals in early life are important causes of disease and dysfunction in children and also in adults.

- Diseases caused by chemicals can successfully be prevented, thus saving lives, enhancing the quality of life, reducing health care and education costs, and in creasing productivity.

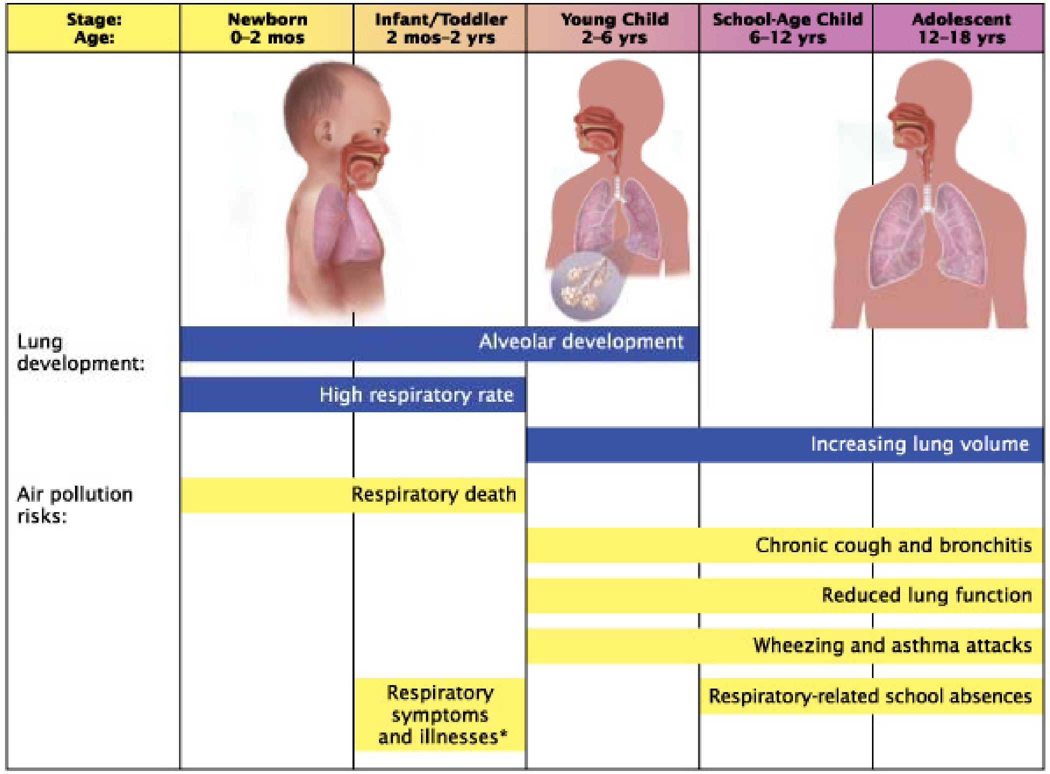


2. Critical Window of Susceptibility



Note: Blue bars indicate time periods when major morphological abnormalities can occur, while light blue bars correspond to periods at risk for minor abnormalities and functional defects.

Figure 1. Fetal development and timing of air pollution risks.



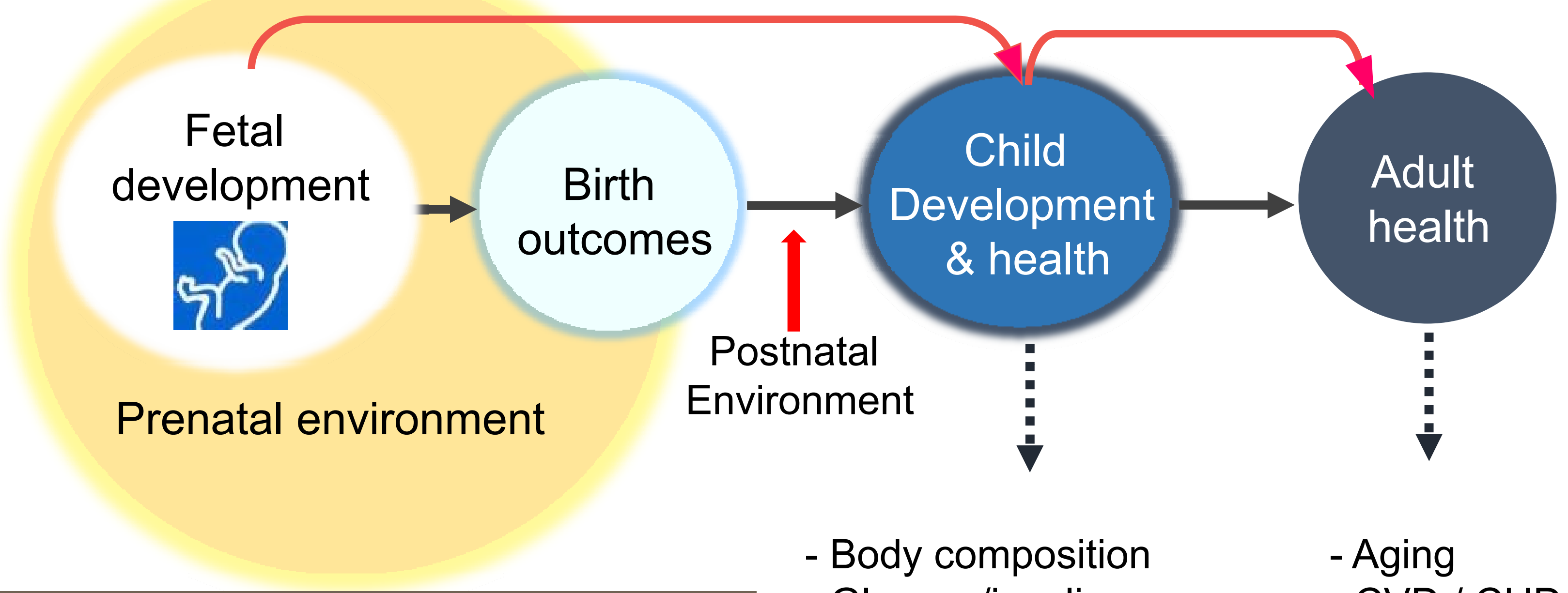
*Air pollution exposure has also been more recently linked to respiratory symptoms and illnesses in early life including cough, bronchitis, wheeze and ear infections

Figure 2. Air pollution effects on the developing respiratory system.

UCLA Institute of the Environment and Sustainability, http://www.environment.ucla.edu/reportcard/article1700.html

3. Developmental Origins of Health & Disease

Fetal programming



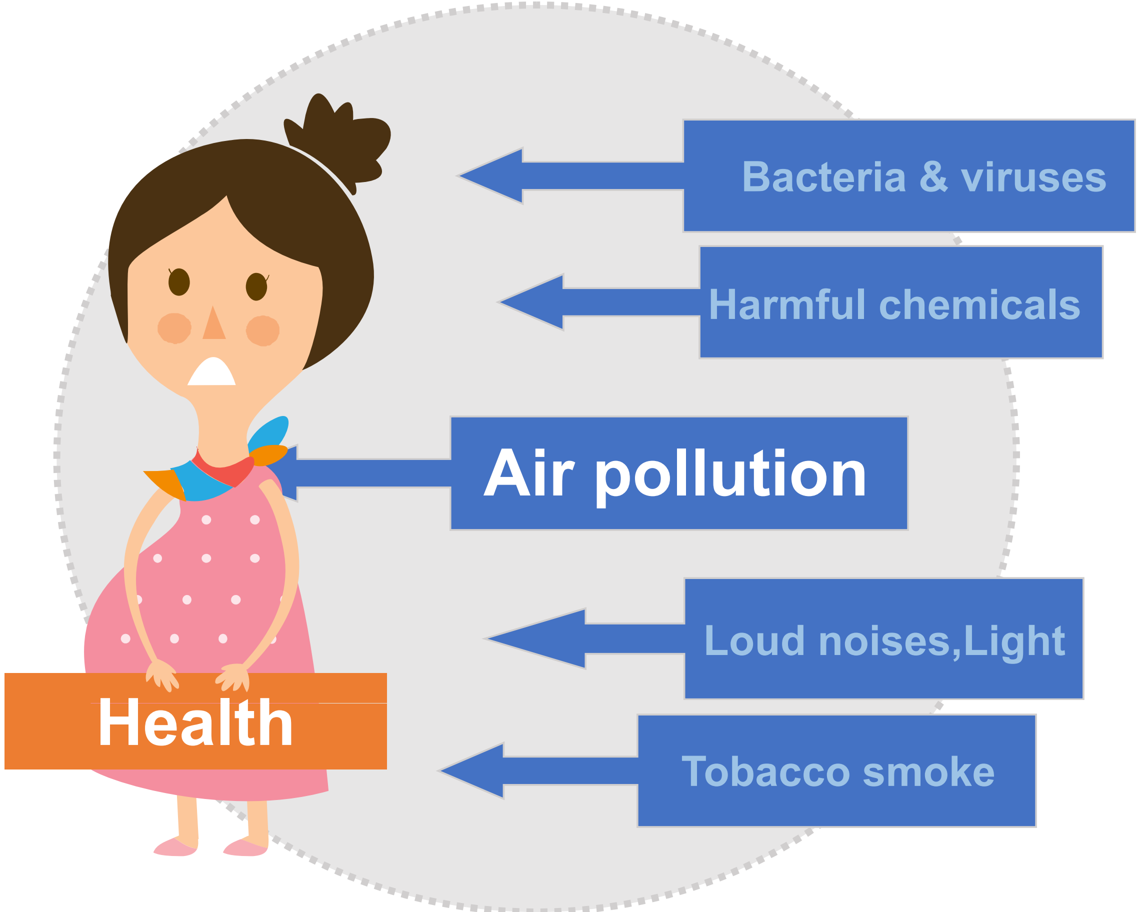
- Body composition
- Glucose/insulin
- Immunocompetence
- Reactive airways
- Allergic diseases
- Premature puberty

- Aging
- CVD / CHD
- Cancer
- Metabolic diseases

…The risks of a number of chronic diseases in adulthood such as insulin dependent diabetes mellitus, hypertension and coronary heart disease may have their origins before birth….

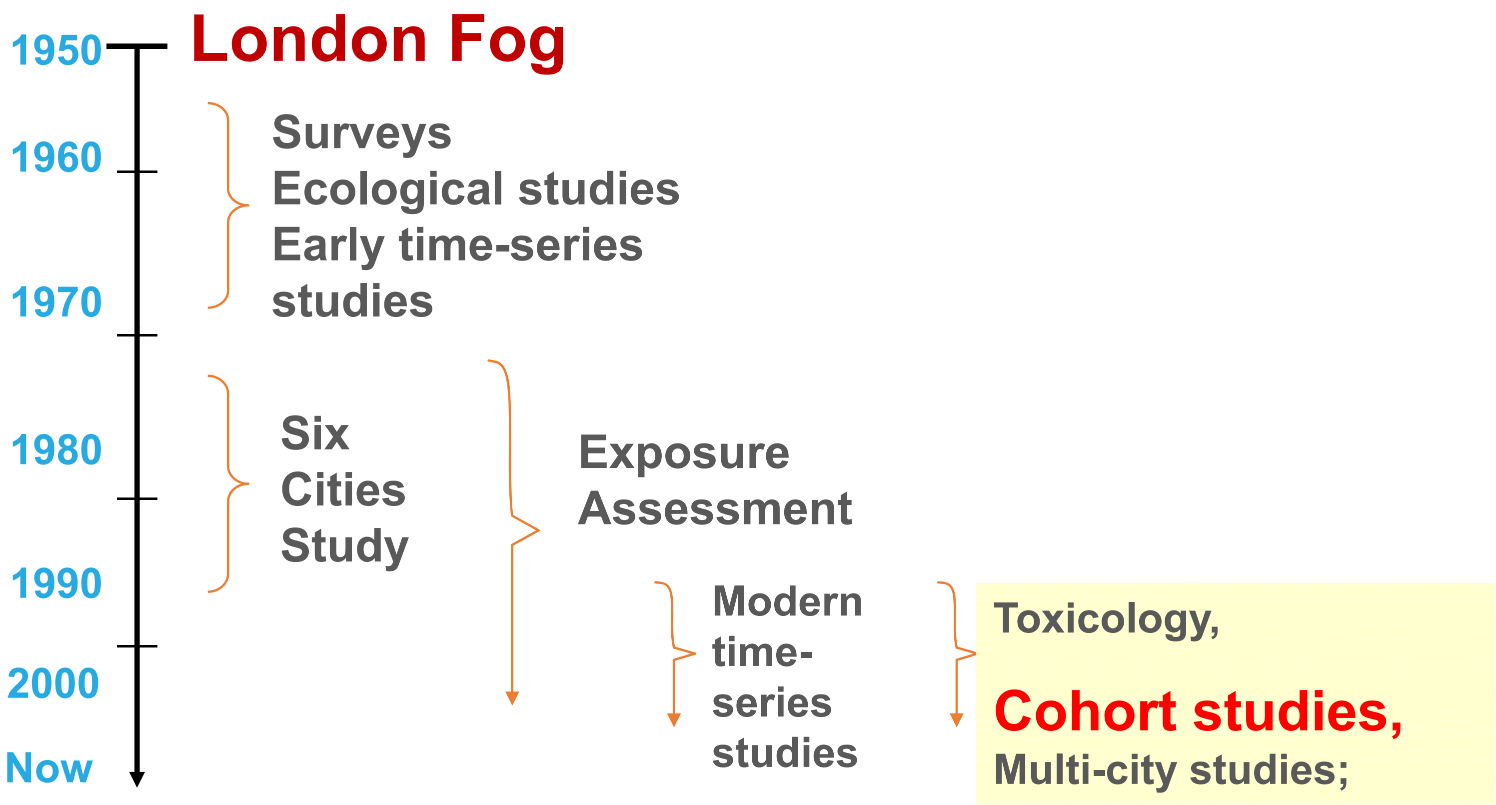
-by Professor David Barker-

III. Air pollution and health

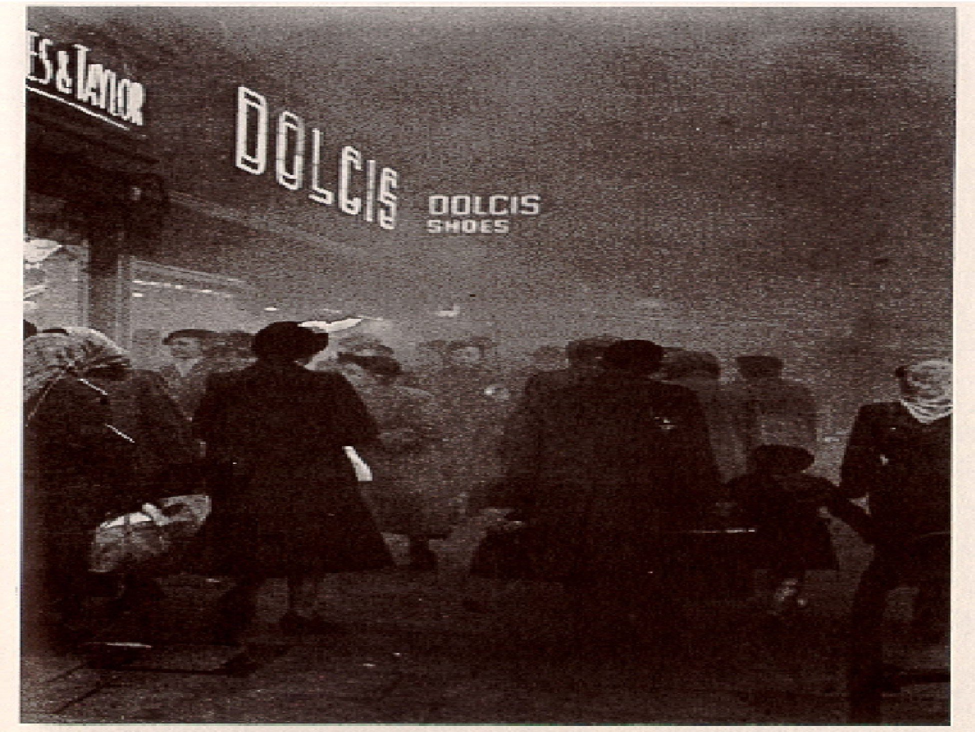


1. Historical episode and Study

- **50+ Years of Air Pollution Research**



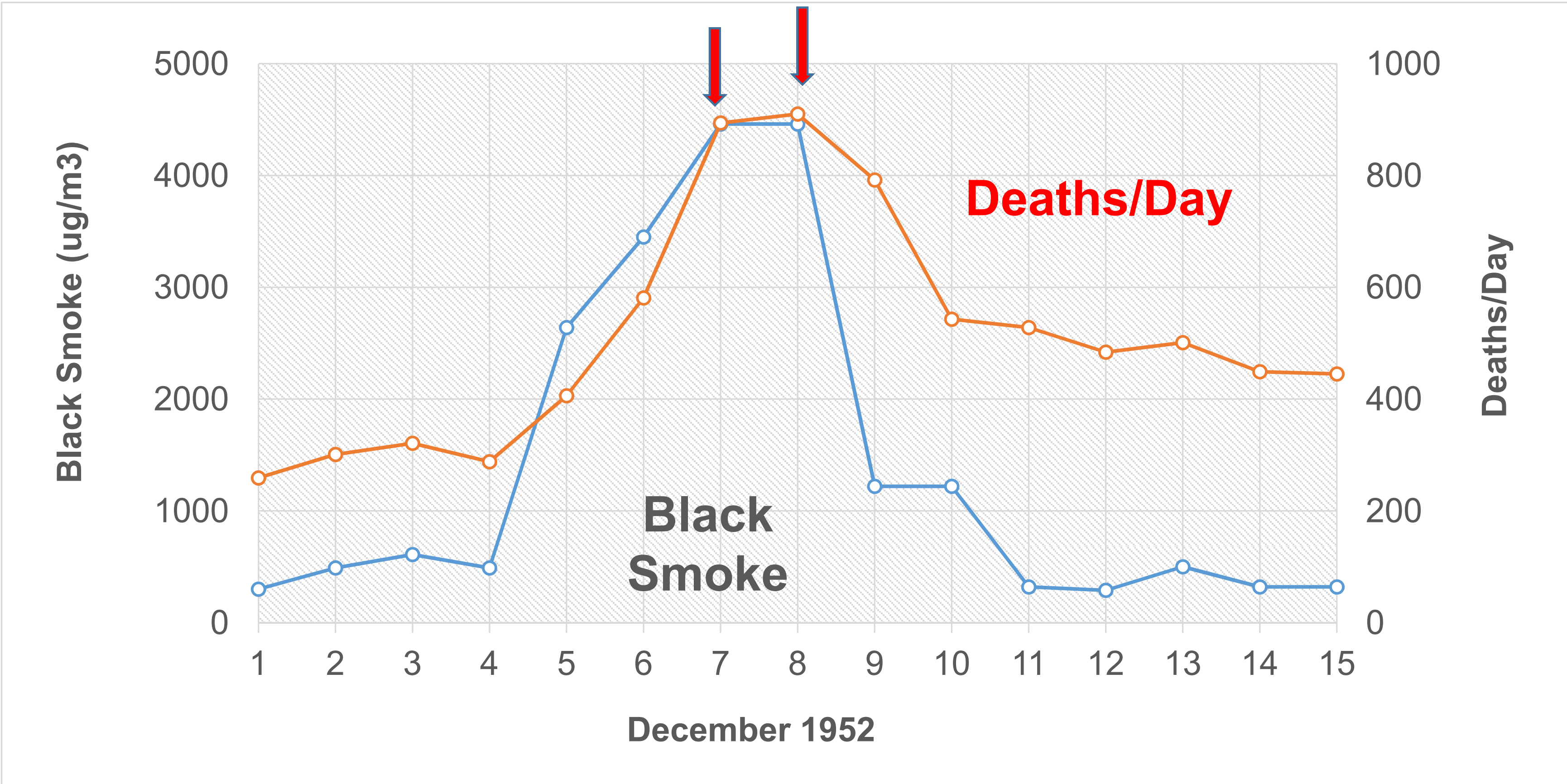
1) London, December 1952

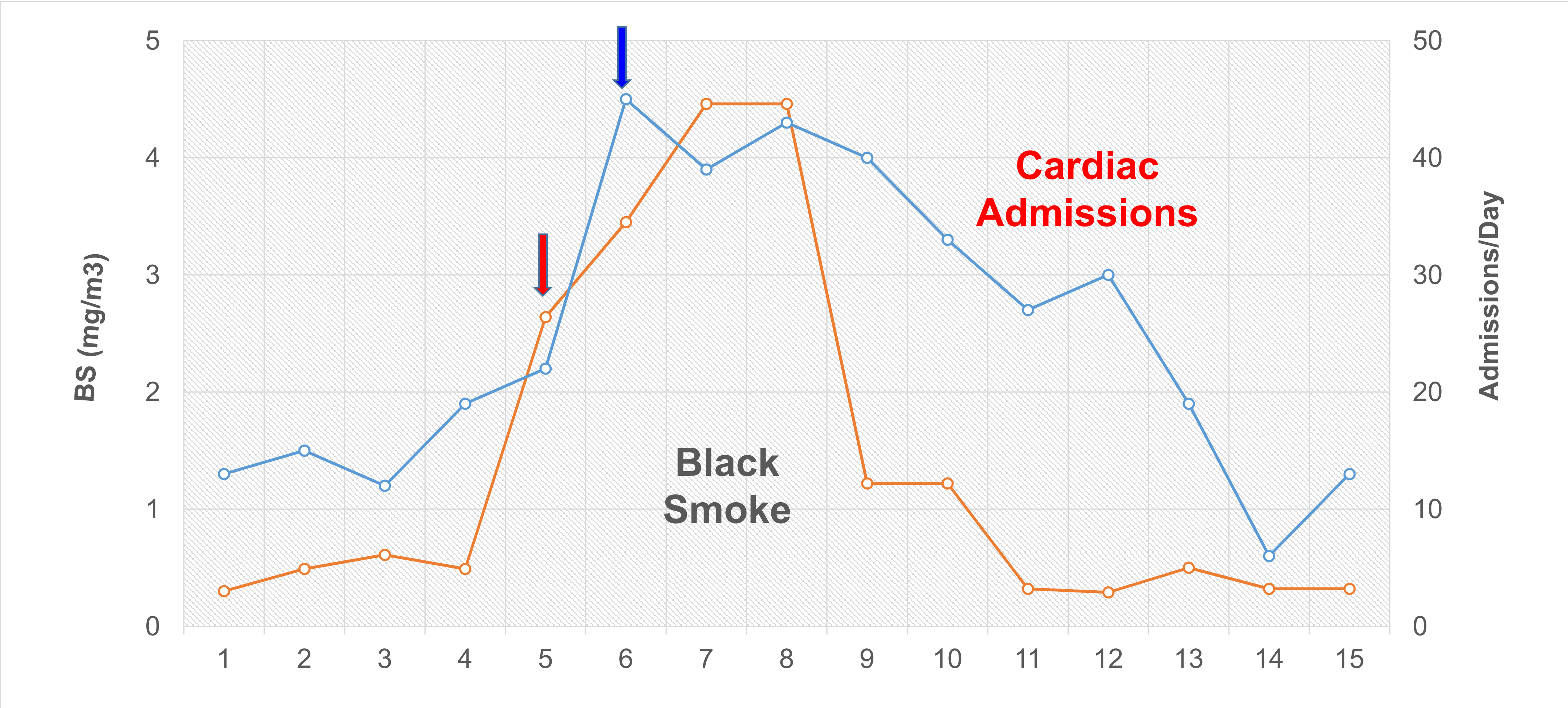


London December 1952,
Picture Taken at Noon

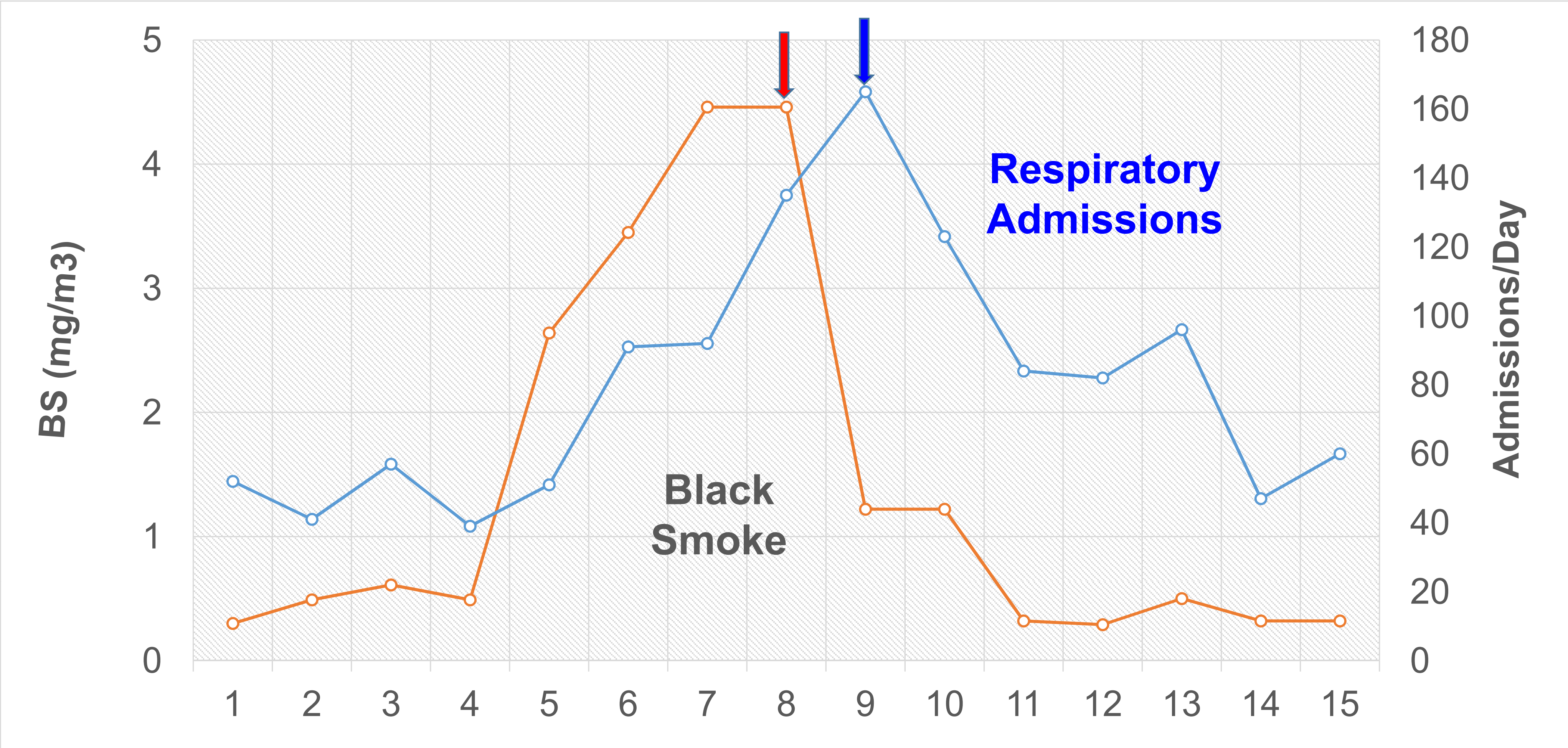
Donora, Pennsylvania Noon,
October 28, 1948

• 1952 London Fog Episode



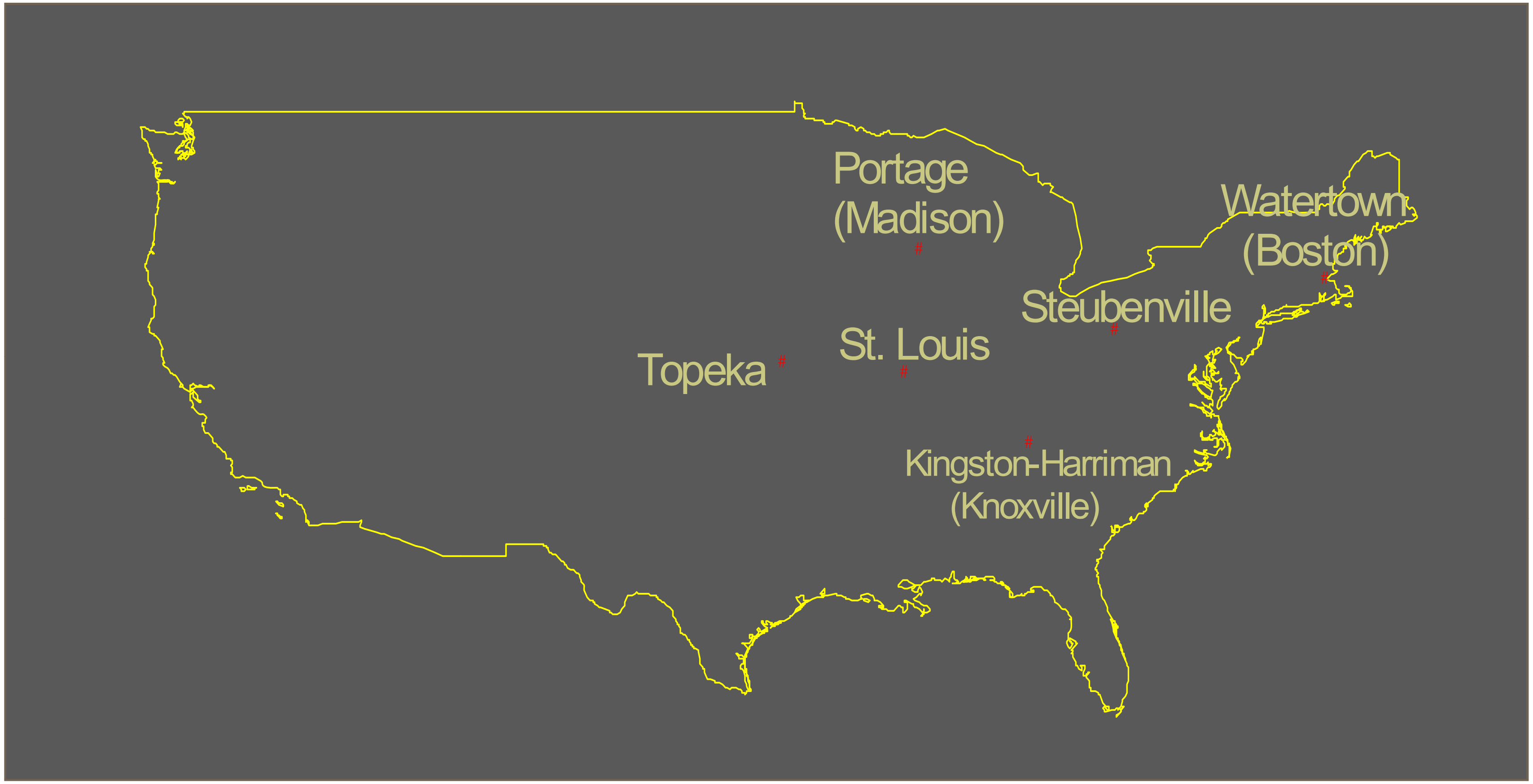


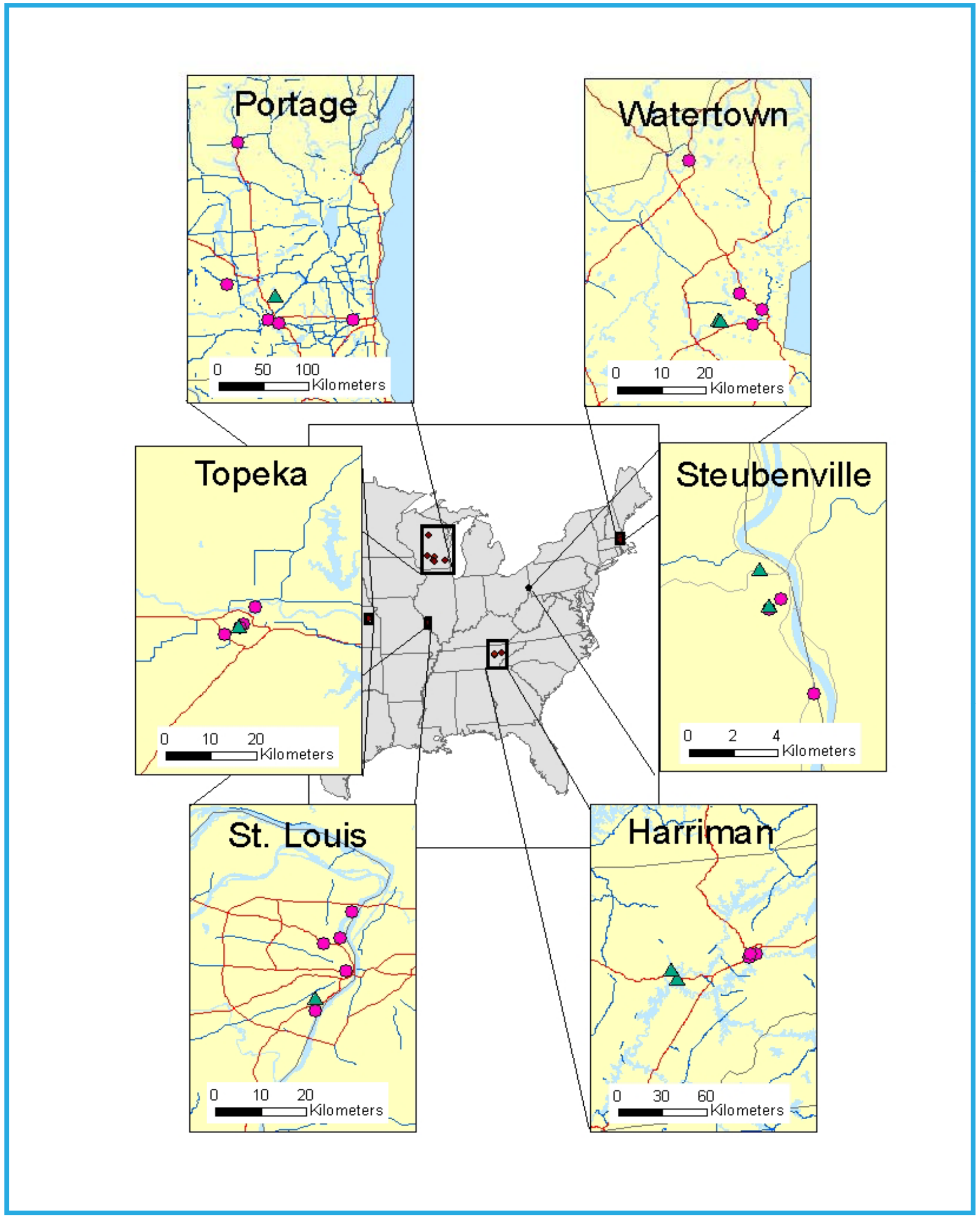
BS (mg/m3)
Admissions/Day
Cardiac Admissions
Black Smoke
0
1
2
3
4
5
0
10
20
30
40
50
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15



BS (mg/m3)
Admissions/Day
Respiratory Admissions
Black Smoke
0
1
2
3
4
5
0
20
40
60
80
100
120
140
160
180
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

2) Harvard 6 Cities Study





▲ Original Six City monitors

● EPA monitors

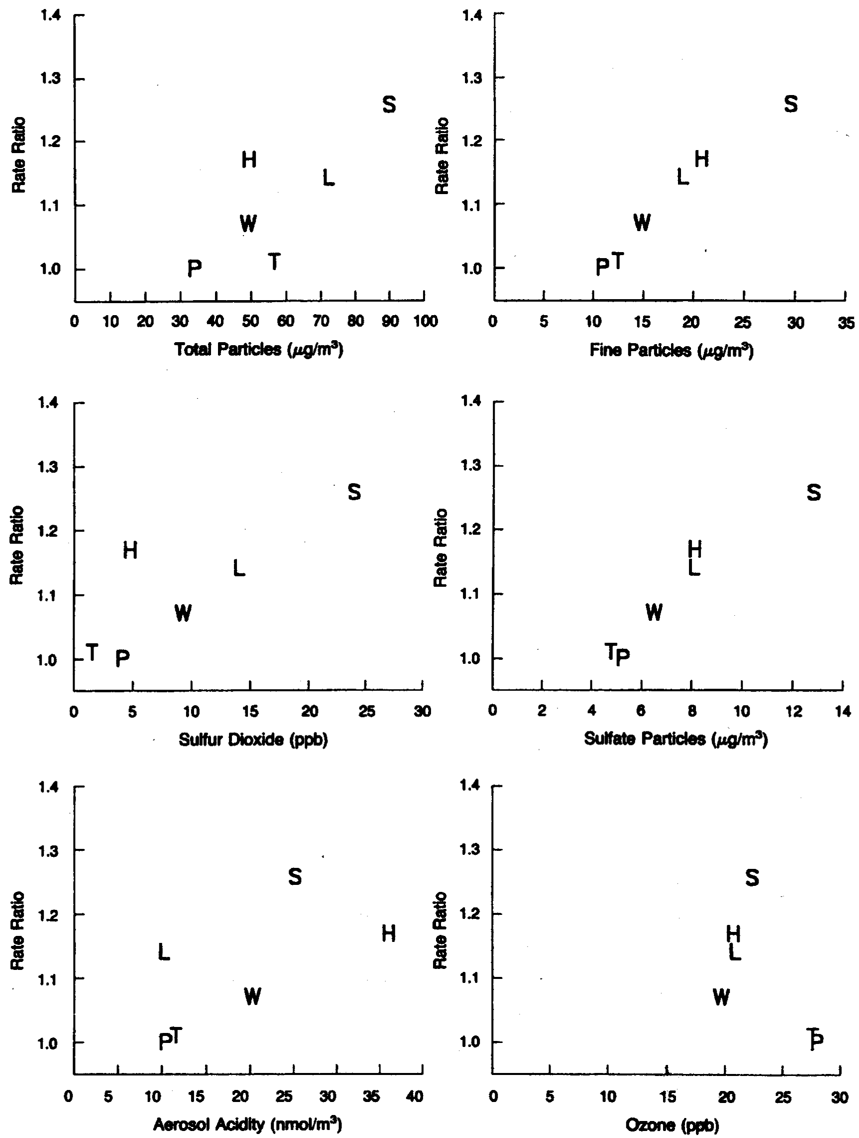
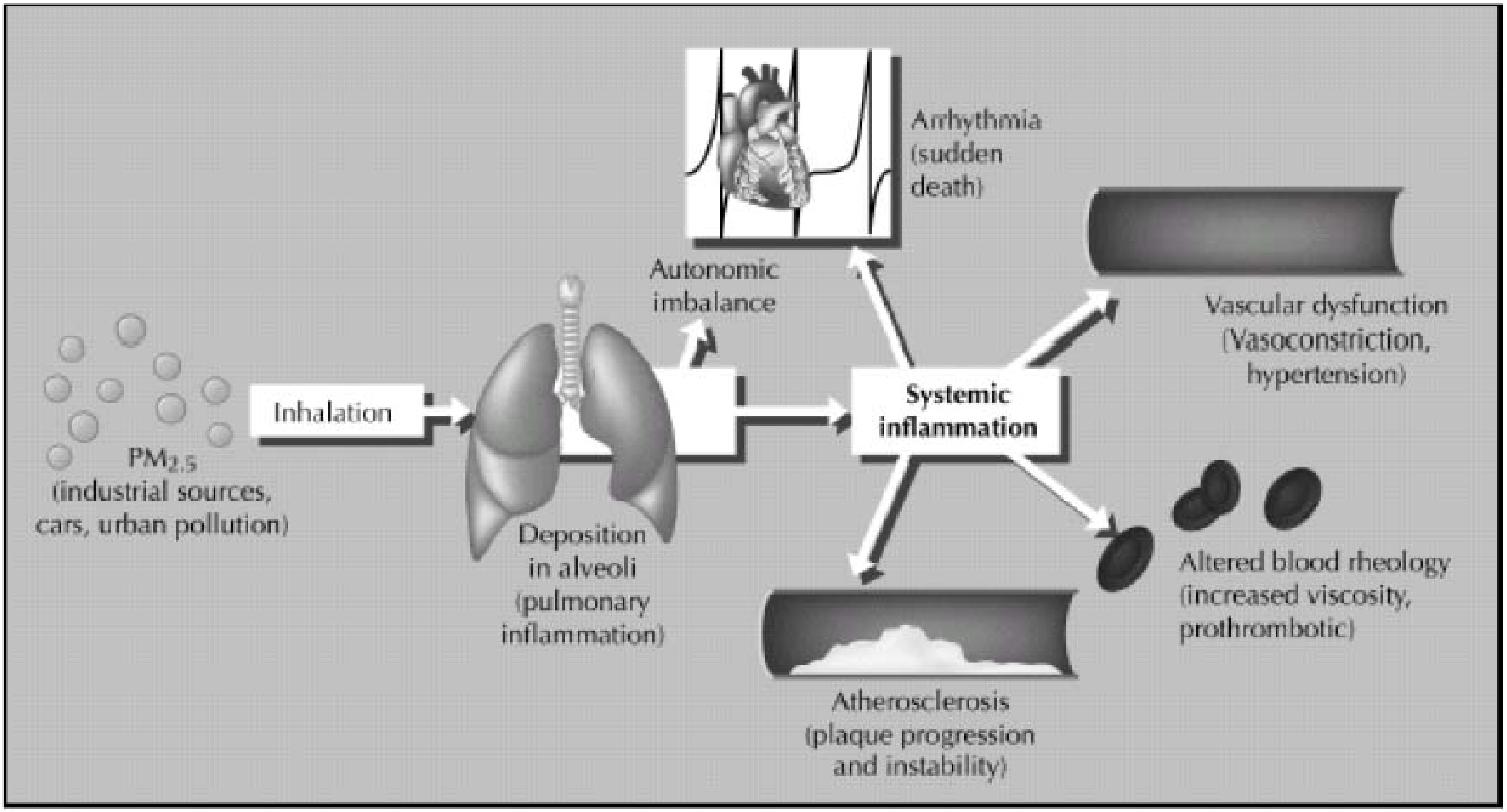


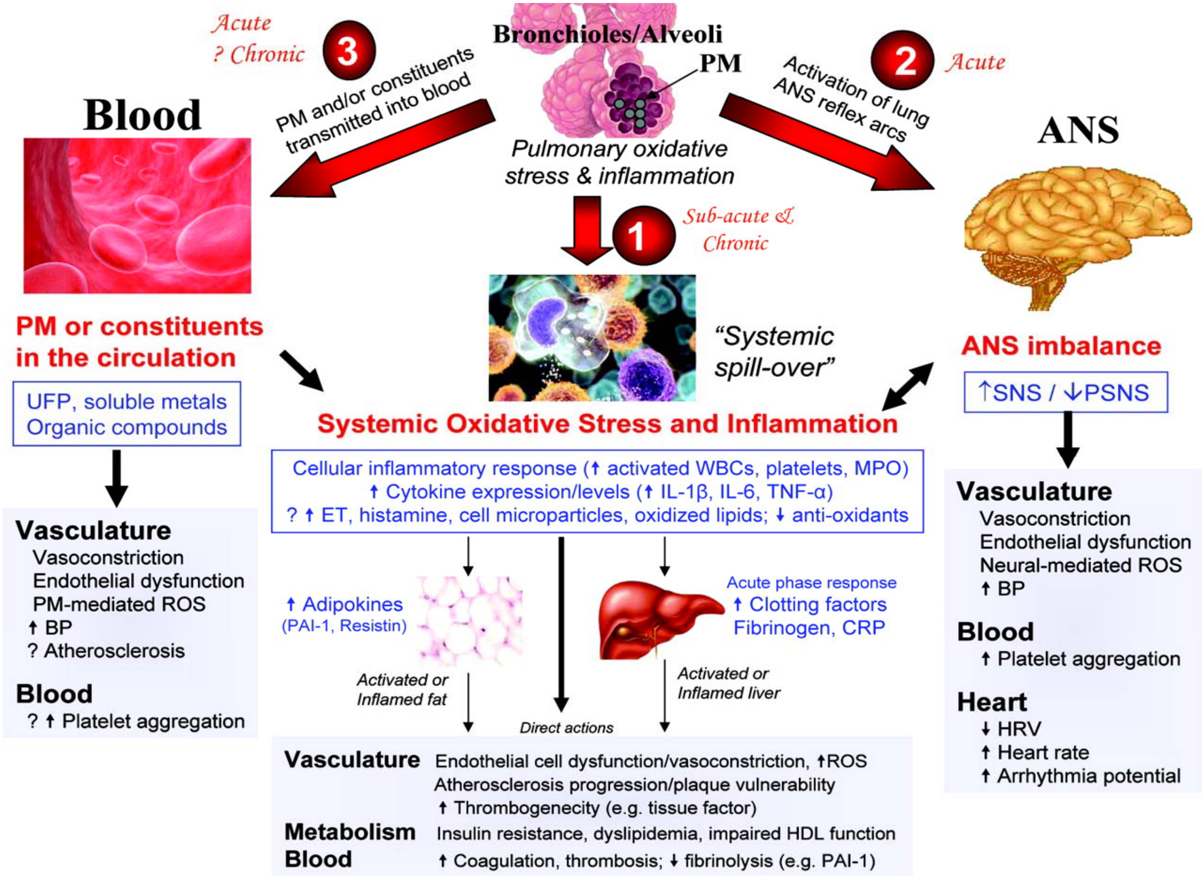
Figure 3. Estimated Adjusted Mortality-Rate Ratios and Pollution Levels in the Six Cities.
Mean values are shown for the measures of air pollution. P denotes Portage, Wisconsin; T Topeka, Kansas; W Watertown, Massachusetts; L St. Louis; H Harriman, Tennessee; and S Steubenville, Ohio.

2. Mechanisms of pathogenesis



Pope CA III et al, 2004

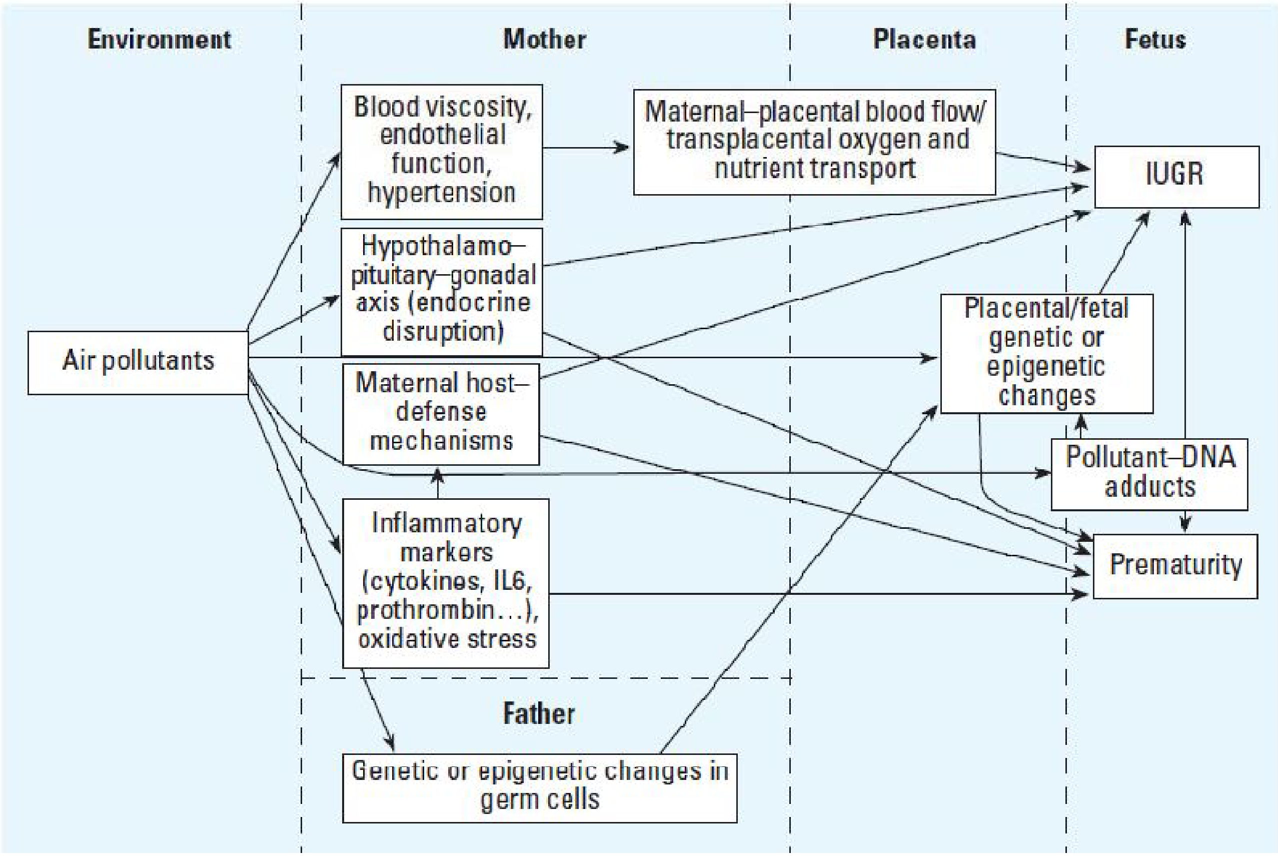
Biological pathways linking PM exposure with CVDs. The 3 generalized intermediary pathways and the subsequent specific biological responses that could be capable of instigating cardiovascular events are shown.



Brook R D et al. *Circulation*. 2010;121:2331-2378

Possible biological mechanisms by which air pollutants may affect birth outcomes

Source : Slama et al. Envrionmental Health Perspective, 2008, 116(6):7953



- Air pollutants effect many biological reactions on mother, placenta and fetus.
- Fine particles can induce oxidative stress and inflammation.
- That contributes to onset of preterm labor and other adverse perinatal outcomes.

3. Air pollutant and Health effect

1) SUMMARY MAJOR OUTDOOR POLLUTANTS

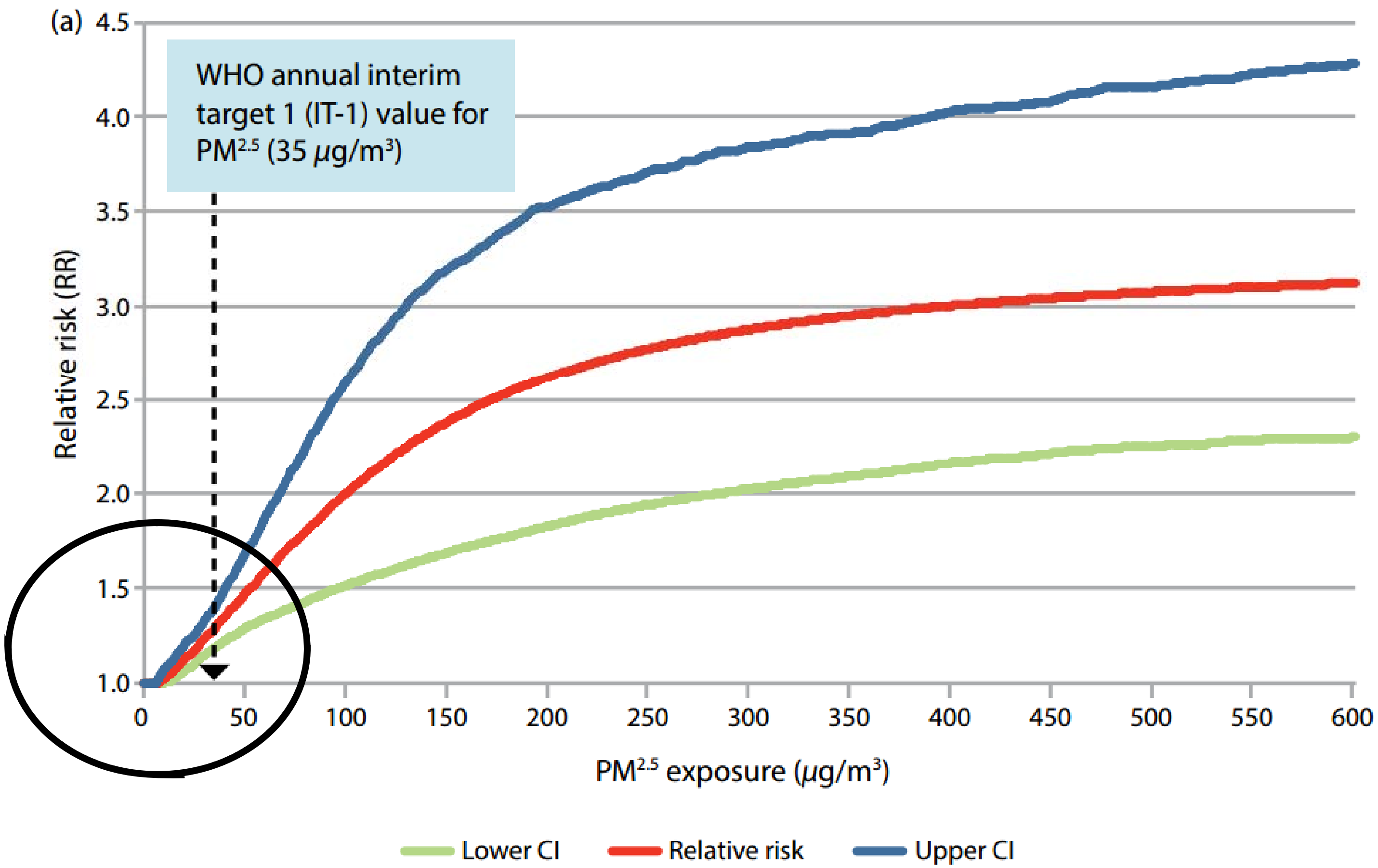
Pollutant	Sources	Health Effects
Particulate Matter	Automobile, bus and truck exhaust, fuel burning (wood st oves, fireplaces), industry, construction.	**↑ infant respiratory mortality** **↓ lung function** **↓ lung growth** **↑ symptoms in asthmatics**
Ozone	Produced when nitrogen oxides (vehicle emissions) and v olatile organic compounds (VOC) chemically react under sunlight.	**↓ lung growth** **↑ asthma exacerbations** **↑ all respiratory hospitalization** **↑ asthma hospitalization** **↑ asthma ED visit** **↑ school absence for respiratory illness**
Nitrogen dioxide	Results from high temperature fuel combustion and atmo spheric reactions.	**↑ symptoms in asthmatics** **↓ lung growth**
Carbon monoxide	Formed when carbon-containing fuel is not burned compl etely, emitted by motor vehicles more than any other sour ce.	**↑ asthma hospitalization** **↑ clinic visits for lower respiratory tract disease headache**
Sulfur dioxide	**Industrial sites such as smelters, paper mills, power plants and steel manufacturing plants are the main s ources.**	**↑ asthma hospitalization** **↑ clinic visits for lower respiratory tract disease**

http://www.who.int/ceh/capacity/Outdoor_air_pollution.pdf

2) Studies for the relationship between PM and low birth weight

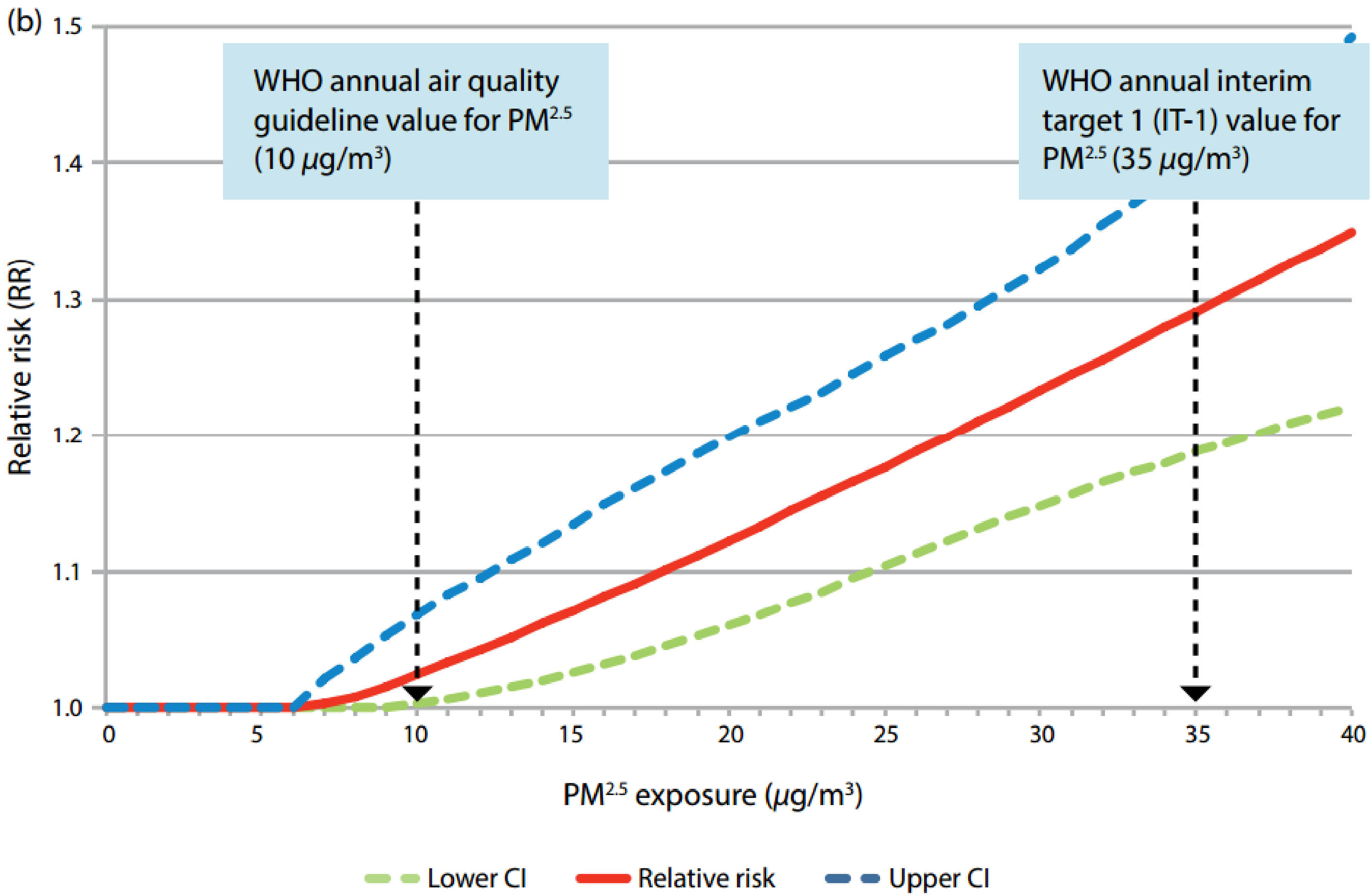
Author	Substance	Published Year	Exposure period (trimester)	Effect size§
Vinikoor-Imler et al.	PM2.5	2014	Entire	Null associations
Wilhelm et al.	PM2.5	2012	Entire	From gasoline IQR OR 1.07 (0.97,1.18) From diesel IQR OR 1.06 (0.99,1.14)
Madsen et al.	PM2.5/PM10	2010	Entire	Null associations
Seo et al.	PM10	2010	Entire	Pusan city OR 1.24 (1.02-1.52)* Daegu city OR 1.19 (1.04-1.37)*
Morello-Frosch et al.	PM2.5/PM10	2010	Entire	An increase of 10 ㎍/㎥ of PM2.5 lowered 12.8g (11.3g-14.3g) of birth weight An increase of 10 ㎍/㎥ of PM10 lowered 7.7g (6.6g-7.9g) of birth weight
Xu et al.	PM10	2010	First Second	IQR AOR 1.13 (1.02, 1.25)* IQR AOR 1.10 (1.00-1.22)*
Bell et al.	PM2.5/PM10	2007	Entire	PM2.5 IQR OR 1.05 (1.02–1.09)* PM10 IQR OR 1.03 (0.99-1.06)
Slama et al.	PM2.5	2007	Entire	Lowest vs highest quartile PR 1.7 (1.2-2.7)*
Dugandzic et al.	PM10	2006	First	Lowest vs highest quartile RR 1.33 (1.02-1.74)*
Salam et al.	PM10	2005	Third	An increase of 20 ㎍/㎥ lowered 21.7g (1.1g-42.2g)* of birth weight
Gouveia et al.	PM10	2004	Second	Lowest vs highest quartile AOR 1.25 (1.03-1.53)*
Lin et al.	PM10	2004	Entire	Null associations
Lee et al.	PM10	2003	First Second	IQR OR 1.03 (1.00-1.07)* IQR OR 1.04 (1.00-1.08)*

3) The relationship between level of PM2.5 exposure (µg/m3) and relative risk (95% CI) of child ALRI, based on the integrated exposure-response (IER) function, for (a) exposure over the range 0–600 µg/m3



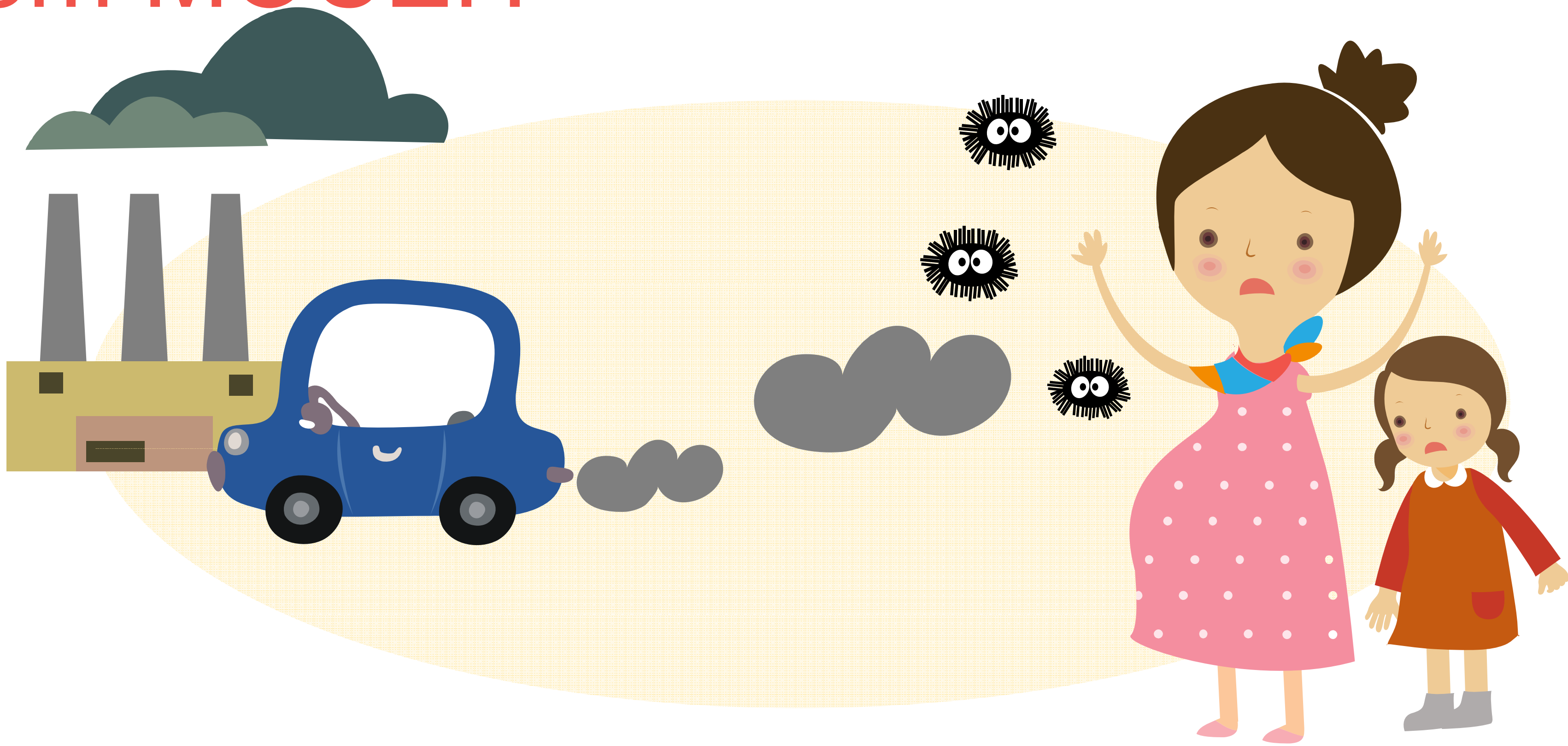
WHO indoor air quality guidelines: household fuel combustion - See more at: http://apps.who.int/iris/handle/10665/141496#sthash.SyqtYxhA.dpuf

(b) over the range 0–40 μg/m3 which spans the WHO annual AQG for PM2.5



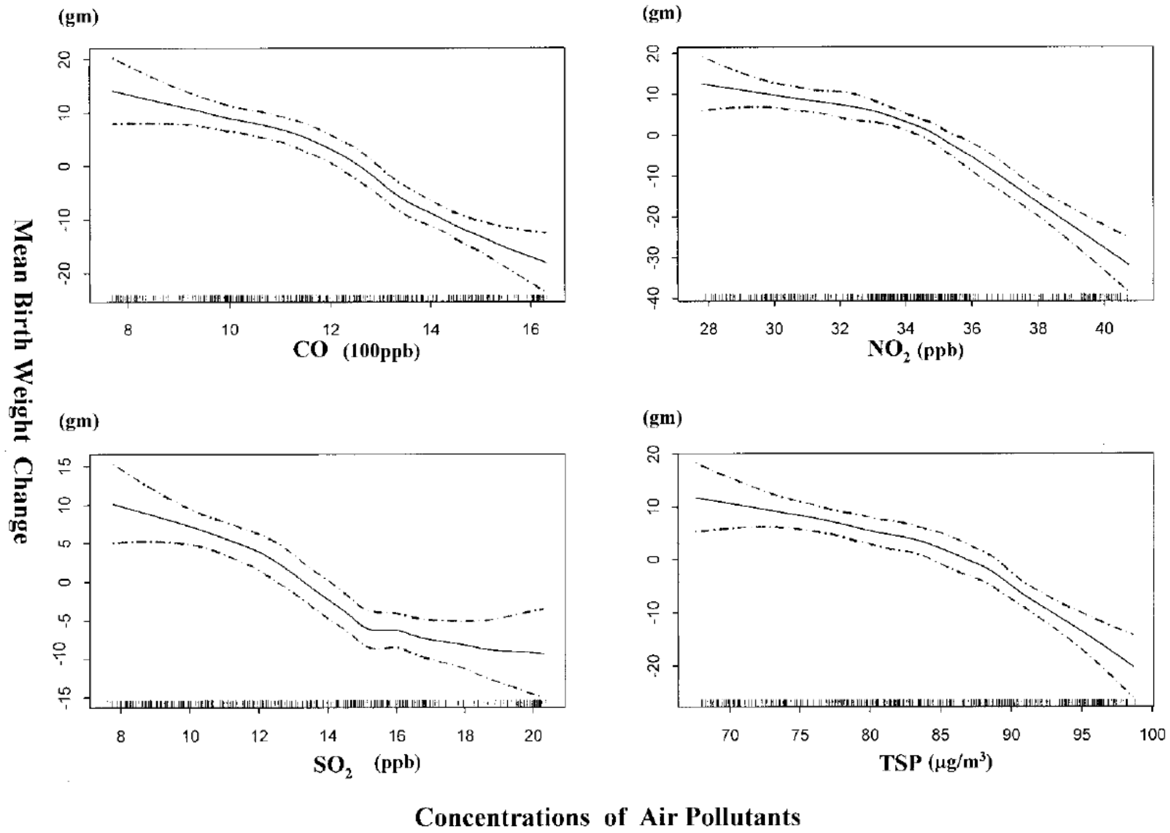
WHO indoor air quality guidelines: household fuel combustion - See more at: http://apps.who.int/iris/handle/10665/141496#sthash.SyqtYxhA.dpuf

IV. Air pollution and Pregnancy outcome and children’s health:some evidences from MOCEH



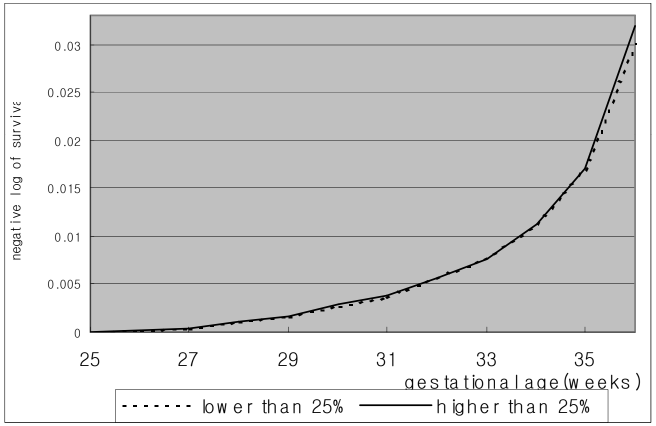
1. Mother graph of MOCEH

- Carbon monoxide, nitrogen dioxide, sulfur dioxide, and total suspended particle concentrations in the first trimester of pregnancy period are risk factors for low birth weight.

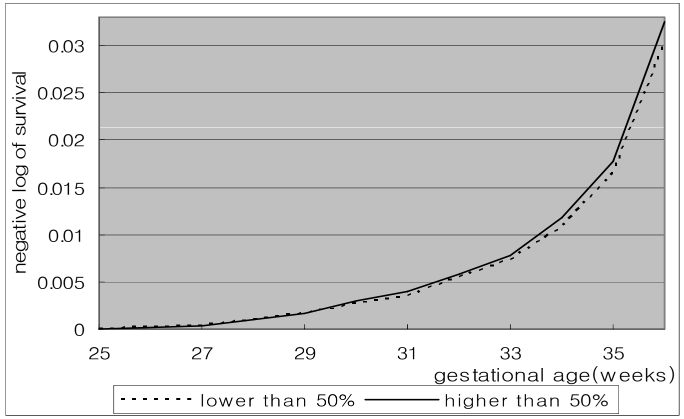


Eun-Hee Ha et al, Is Air Pollution a Risk Factor for Low Birth Weight in Seoul? EPIDEMIOLOGY, 2001

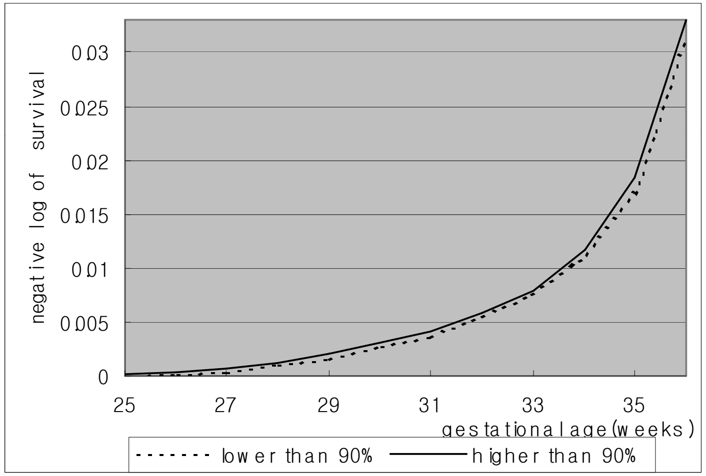
Difference of cumulative hazard functions between low and high PM_{10} concentration groups during the seventh month of pregnancy



(a) Divided on the basis of 25% value of PM_{10}



(b) Divided on the basis of median of PM_{10}



(c) Divided on the basis of 90% value of PM_{10}

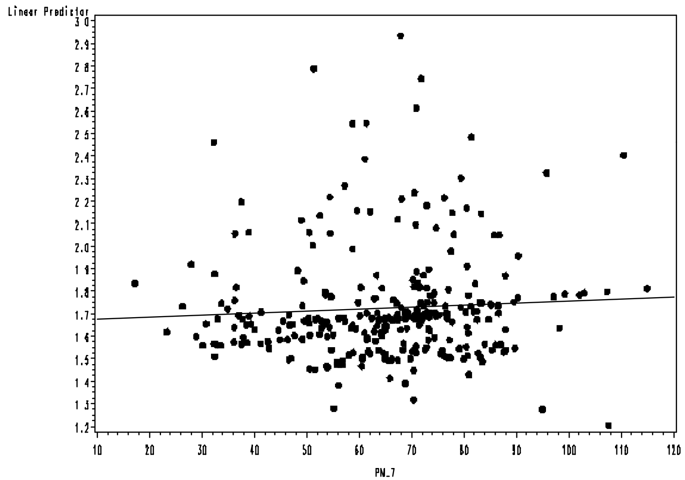
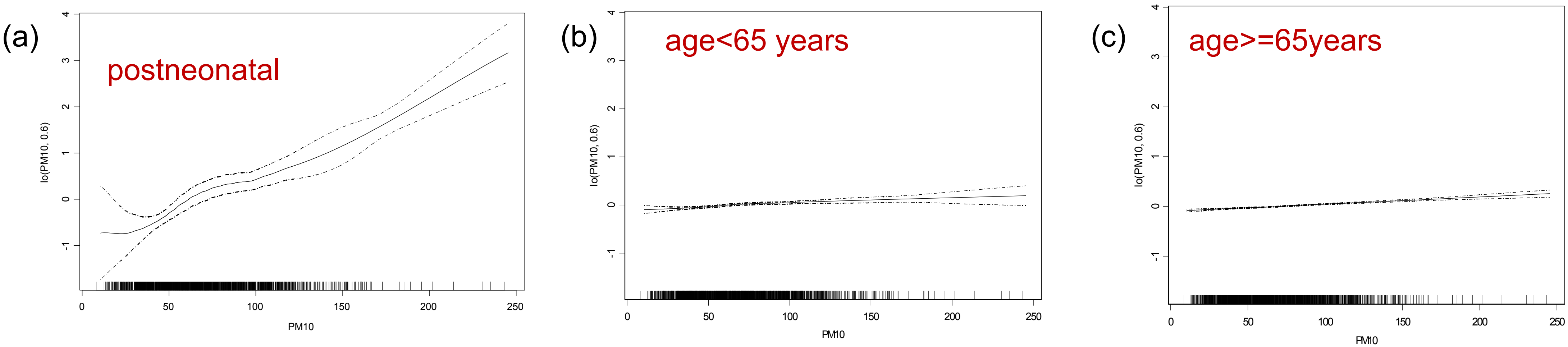


Figure 2. Difference of cumulative hazard functions between low and high PM_{10} concentration groups during the seventh month of pregnancy

Ha EH et al, JPM&PH 2007



Regarding respiratory mortality, RR for an interquartile change of PM(10) in postneonates (RR: 2.018; 95% CI: 1.784-2.283) was also greater than those in the otsaher groups.

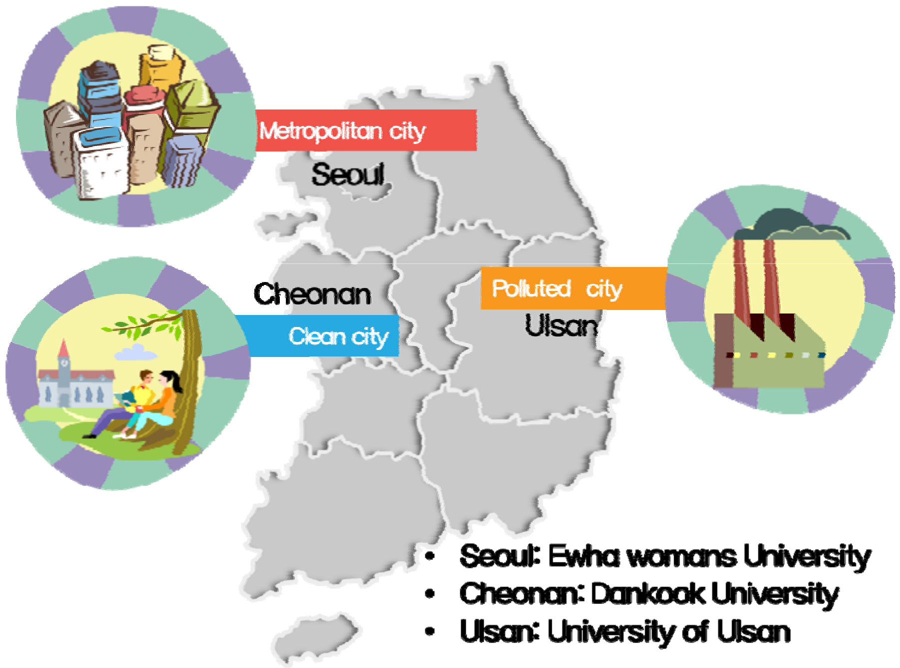
Infant susceptibility of mortality to air pollution in Seoul, South Korea.
Ha EH et al, Pediatrics 2003

2. Brief Introduction to MOCEH

1) Scope of research

- In Korea, the National Environmental Health Action Plan (NEHAP, 2006) developed by the Ministry of Environment outlines strategies for eliminating environmental health hazards and reducing their adverse effects on pregnant women and their children.

- In 2006, the Mothers and Children's Environmental Health (MOCEH) study, a multi-center prospective cohort study, began as an initiative of the NEHAP.



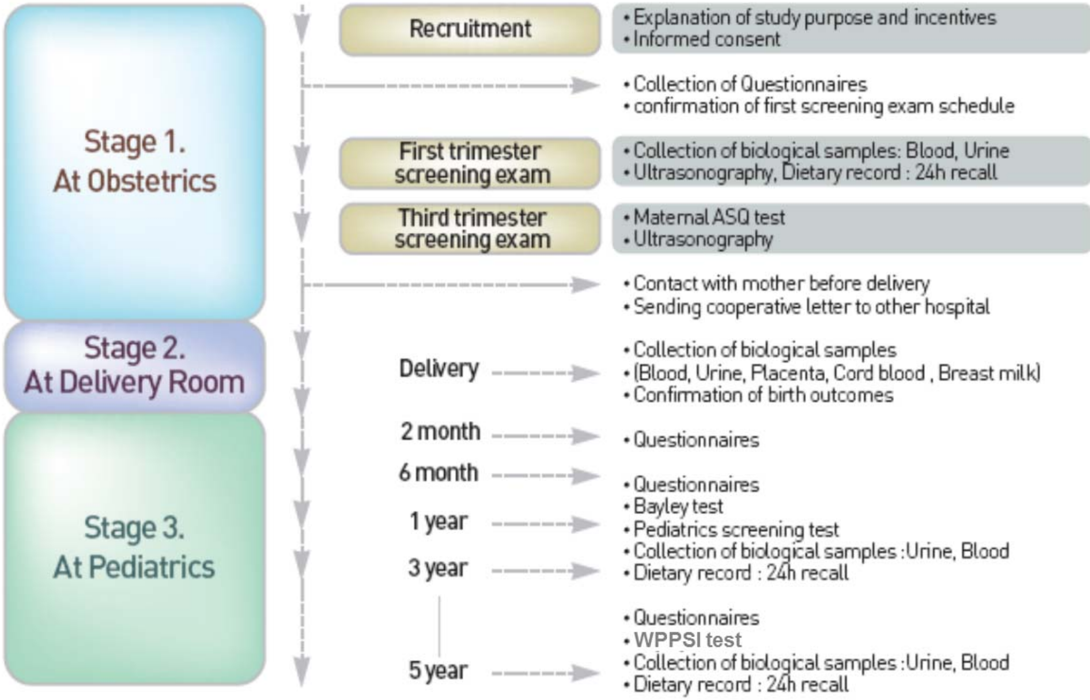
2) Study process

Assessment of determinants

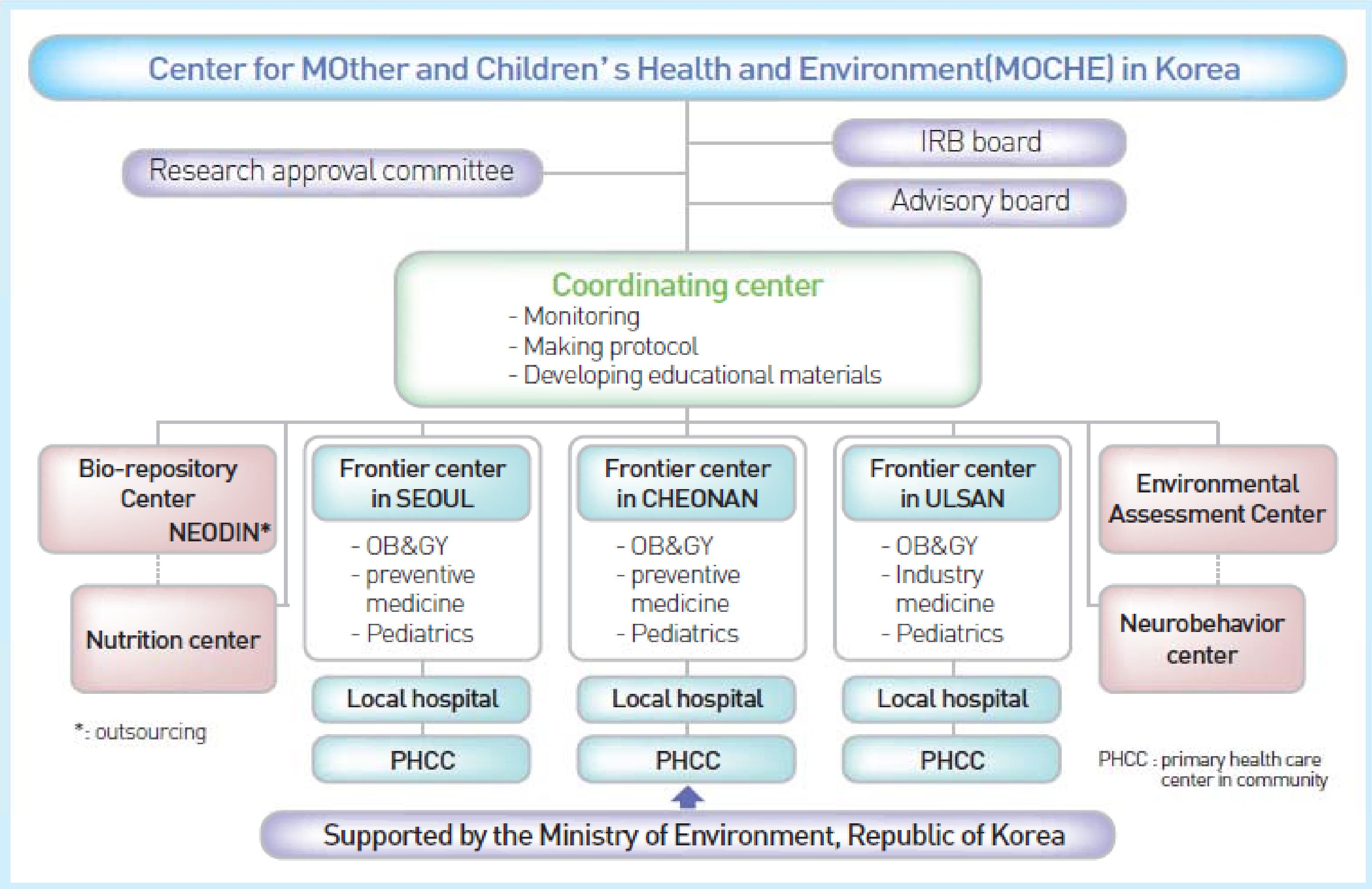
- Questionnaires
- **Measurements of environmental pollutants (Home visiting)**
- Biological samples
- Dietary information

Assessment of outcomes

- Intrauterine growth
- Birth outcomes
- Growth and development
- Neurocognitive development
- Atopy, allergy, and asthma in children

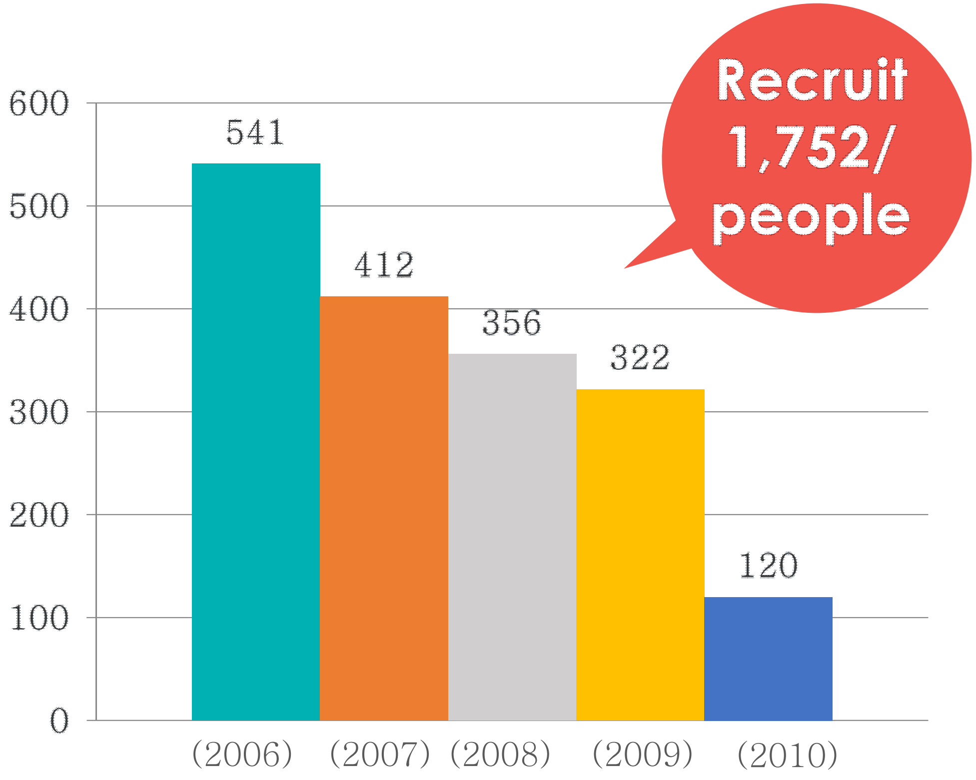


3) Community-Hospital based collaborative network

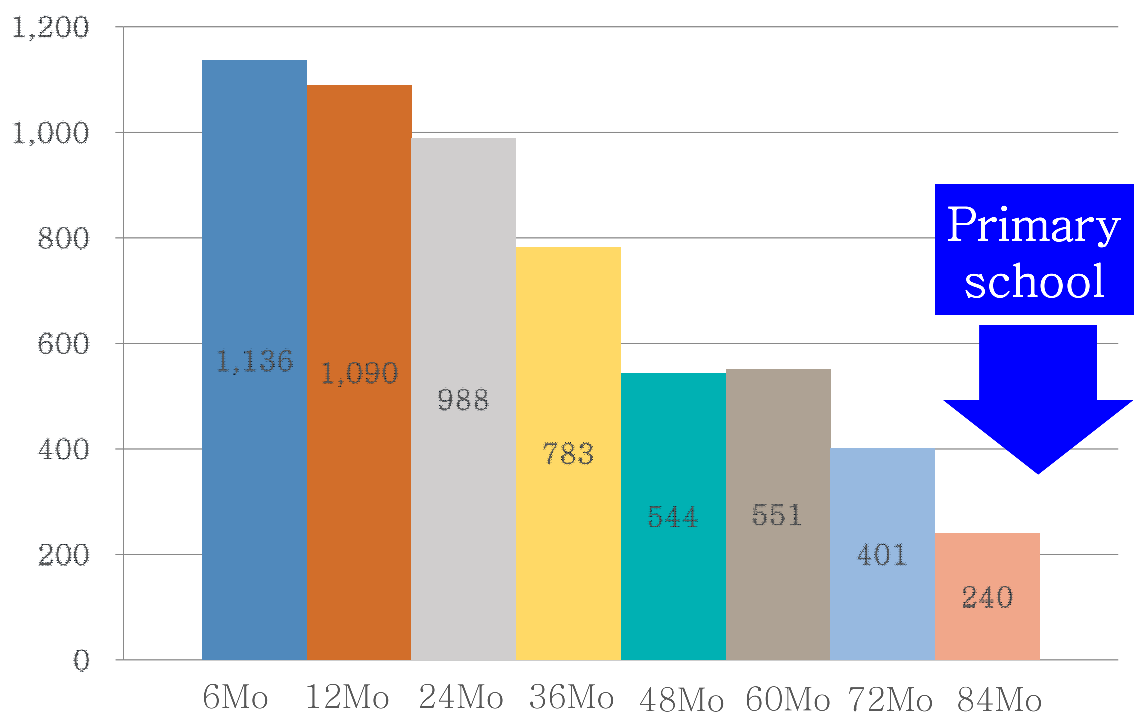


4) Recruitment Results

(1) Cohort of pregnant women



(2) Cohort of infants

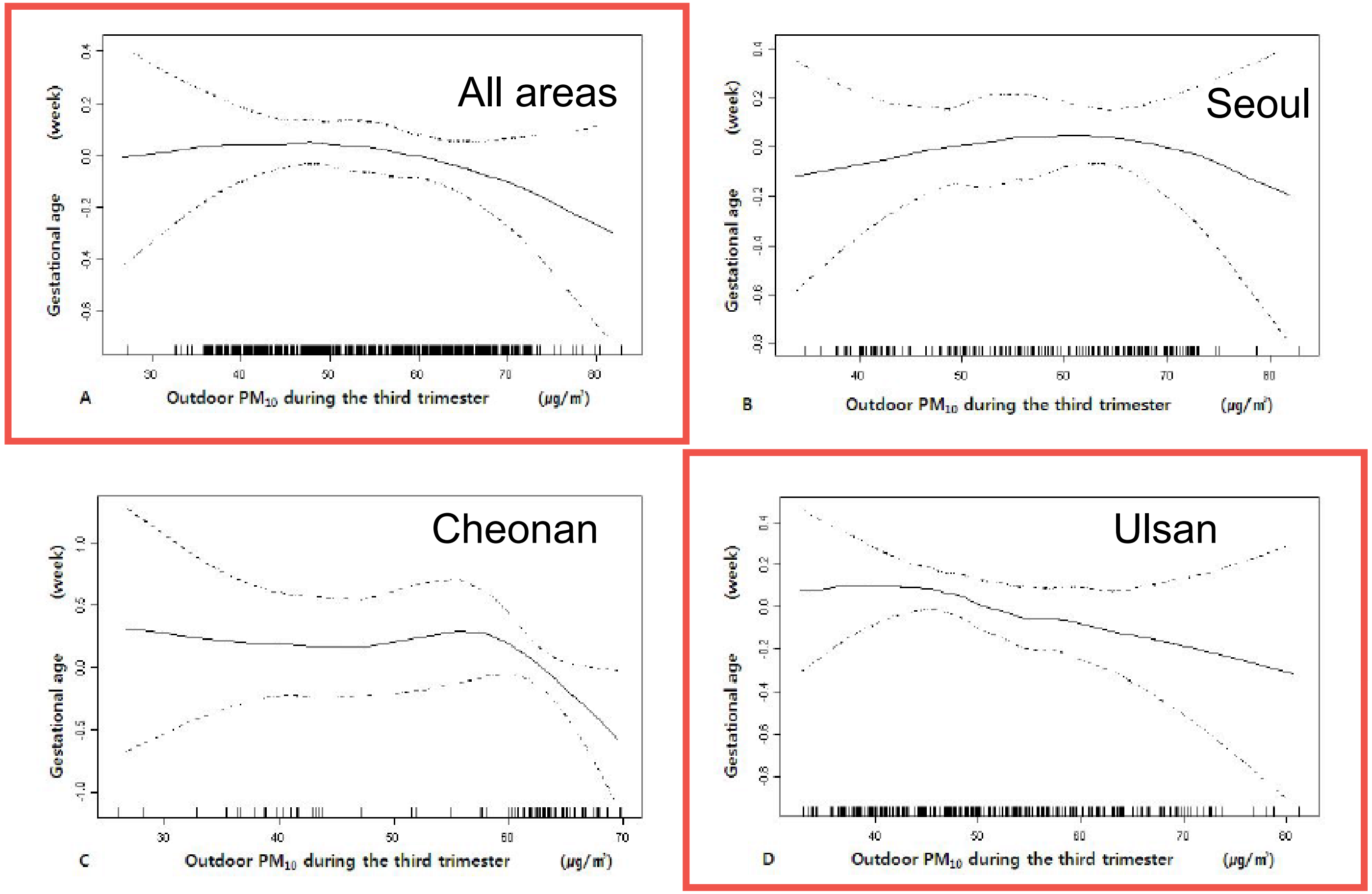


3. Air pollution and children's health: Some evidences from MOCEH study

- **Particulate Matter(PM10)**
- VOCs/HCHO

- **Particulate Matter(PM10)**
- VOCs/HCHO

1) Gestational age for third trimester of outdoor PM_{10}



* Adjusted controlling for maternal age, maternal education, baby sex, BMI, house age, and factory

2) Personal exposure PM10 and growth development

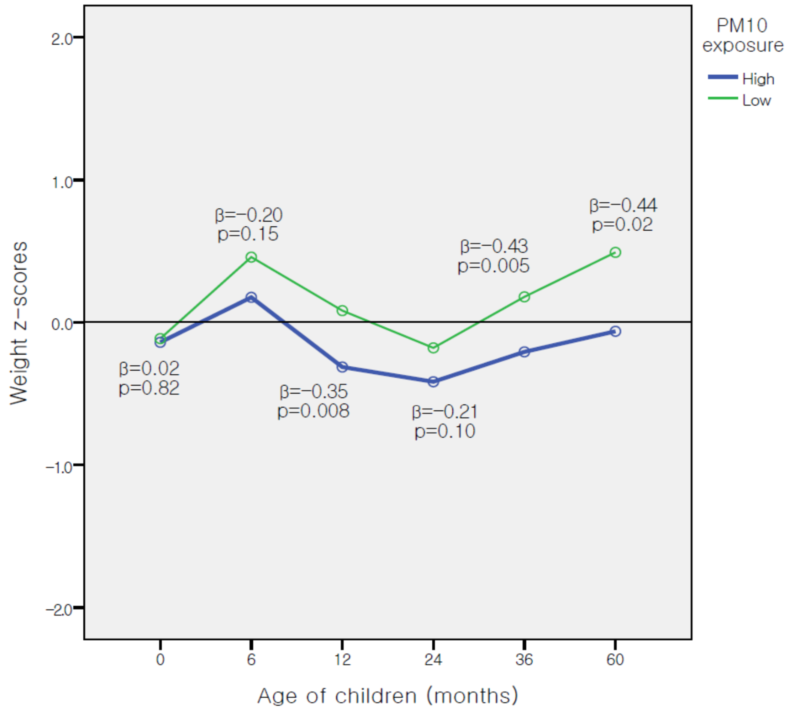
Association of PM10 exposure with children's weight z-scores (GLM)

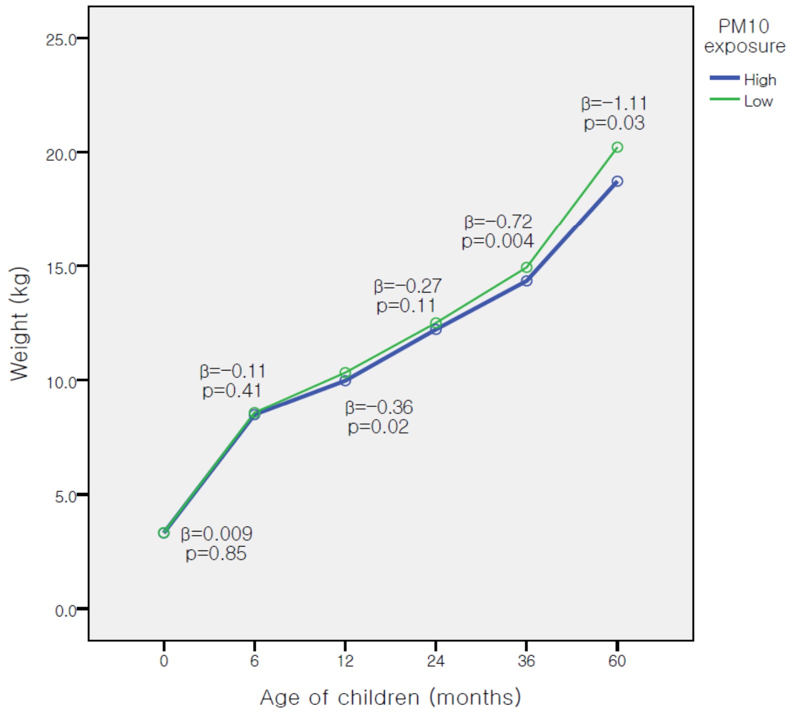
Measured period		Change in weight for age z-scores (95% confidence intervals)			
PM10 (10 ㎍/㎥)	**Weight**	**N**	**Model 1***	**N**	**Model 2***
Prenatal	At birth	1,129	-0.004 (-0.07, 0.06)	N/A	N/A
	6 months	812	-0.02 (-0.12, 0.09)	740	-0.03 (-0.14, 0.08)
	12 months	728	-0.09 (-0.19, 0.007)	638	-0.11 (-0.21, -0.002)
	24 months	648	-0.06 (-0.17, 0.05)	595	-0.03 (-0.14, 0.09)
	36 months	545	-0.06 (-0.19, 0.07)	481	-0.06 (-0.20, 0.07)
	60 months	387	-0.12 (-0.29, 0.06)	340	-0.16 (-0.35, 0.03)
0-6 months	6 months	812	-0.07 (-0.15, 0.01)	740	-0.08 (-0.17, 0.006)
	12 months	728	0.02 (-0.06, 0.10)	638	0.002 (-0.08, 0.08)
	24 months	648	-0.01 (-0.10, 0.09)	595	0.004 (-0.09, 0.10)
	36 months	545	0.08 (-0.02, 0.19)	481	0.01 (-0.01, 0.21)
	60 months	387	-0.04 (-0.17, 0.08)	340	-0.08 (-0.22, 0.06)
7-12 months	12 months	728	-0.13 (-0.21, -0.05)	638	-0.14 (-0.22, -0.05)
	24 months	648	-0.08 (-0.18, 0.01)	595	-0.06 (-0.15, 0.04)
	36 months	545	-0.15 (-0.25, -0.04)	481	-0.16 (-0.37, -0.05)
	60 months	387	-0.17 (-0.29, -0.04)	340	-0.19 (-0.34, -0.06)
13-24 months	24 months	648	-0.12 (-0.26, 0.02)	595	-0.07 (-0.23, 0.08)
	36 months	545	-0.03 (-0.19, 0.13)	481	-0.02 (-0.29, 0.16)
	60 months	387	-0.14 (-0.33, 0.06)	340	-0.17 (-0.38, 0.05)
25-36 months	36 months	545	-0.02 (-0.17, 0.14)	481	-0.02 (-0.19, 0.16)
	60 months	387	-0.17 (-0.37, 0.04)	340	-0.20 (-0.45, 0.04)
37-60 months	60 months	286	-0.19 (-0.45, 0.07)	248	-0.22 (-0.51, 0.08)

* The model 1 was adjusted for sex, maternal age, gestational age, maternal education, family income, birth weight, and maternal body mass index.

The model 2 was adjusted for the same covariates in model 1 and feeding method at 6 months.

- Difference of average weight for age z scores and weights between children exposed to PM10 under 50 ㎍/㎥ and over 50 ㎍/㎥ from pregnancy to 24 months

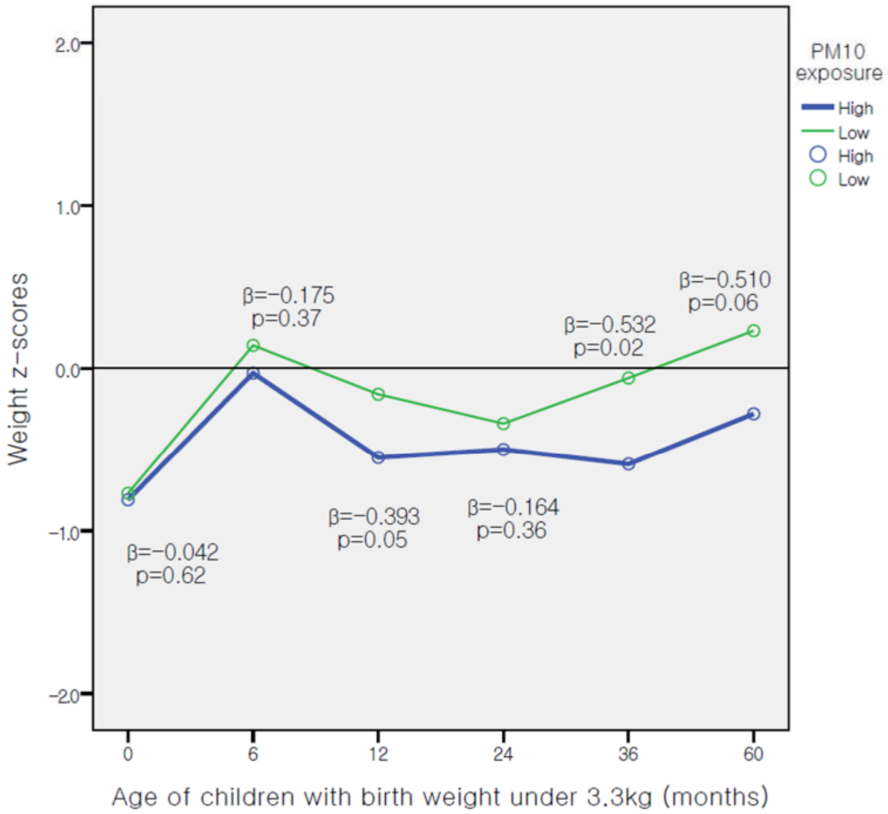


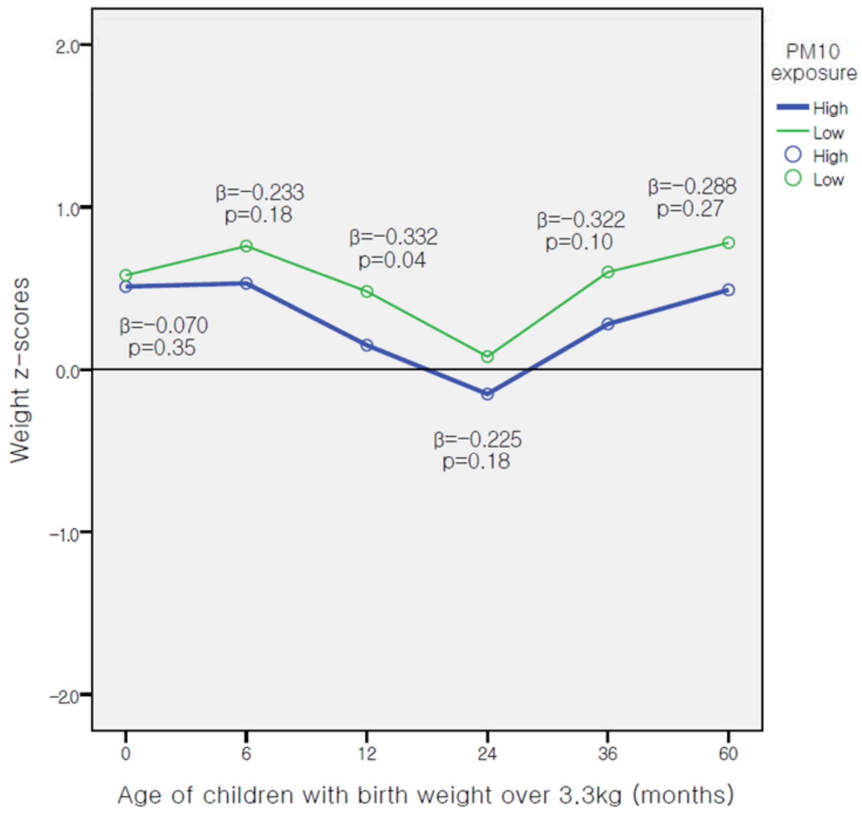


* Total number of participants in the analysis (the number of participants in high exposure group)

At birth: 380 (278), 6 months: 238 (152), 12 months: 213 (137), 24 months: 199 (124), 36 months: 179 (113), 60 months: 124 (79)

- Difference of average weight z-scores between children exposed to PM10 under 50 ㎍/㎥ and over 50 ㎍/㎥ from pregnancy to 24 months in children with birth weight under 3.3 kg and over 3.3 kg





* Total number of participants in the analysis (the number of participants in higher exposure group)
Left - At birth: 183 (132), 6 months: 114 (72), 12 months: 102 (67), 24 months: 102 (65), 36 months: 87 (56), 60 months: 62 (42)
Right - At birth: 197 (146), 6 months: 124 (80), 12 months: 111 (70), 24 months: 97 (59), 36 months: 97 (57), 60 months: 62 (37)

3) Air pollutant and neurodevelopment

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Association of prenatal exposures to PM10 and NO2 with children's neurodevelopment over the period of 24 months of age by general linear model and GEEs.[a]

Table 4
Association of prenatal exposures to PM_{10} and NO_2 with children's neurodevelopment over the period of 24 months of age by the general linear model and GEEs[a] — sub-analysis adjusted for maternal IQ.

		n	MDI		PDI	
			β (LCI, UCI)	p-Value	β (LCI, UCI)	p-Value
PM_{10} (10 μg/m^3)[b]						
GLM[b]	6 months	240	−4.91 (−7.69, −2.12)	<0.001	−8.85 (−12.14, −5.57)	<0.001
	12 months	184	−3.96 (−8.42, 0.51)	0.08	−1.30 (−5.53, 2.93)	0.68
	24 months	184	1.05 (−2.69, 4.79)	0.58	1.93 (−1.74, 5.60)	0.91
GEEs[c]	6 to 24 months	240[e]	−2.81 (−5.17, −0.46)	0.02	−3.57 (−5.96, −1.18)	0.004
GEEs[d]	6 to 24 months	240[e]	−3.41 (−5.88, −0.94)	0.007	−3.93 (−6.37, −1.48)	0.002
NO_2 (10 ppb)[b]						
GLM[b]	6 months	240	−4.11 (−6.26, −1.95)	<0.001	−5.57 (−8.17, −2.97)	<0.001
	12 months	184	−0.85 (−4.86, 3.16)	0.55	−0.91 (−4.68, 2.86)	0.63
	24 months	184	−0.18 (−3.23, 2.88)	0.30	−2.39 (−5.37, 0.60)	0.12
GEEs[c]	6 to 24 months	240[e]	−2.08 (−4.09, −0.08)	0.04	−3.48 (−5.64, −1.32)	0.002
GEEs[d]	6 to 24 months	240[e]	−1.66 (−3.70, 0.38)	0.11	−3.19 (−5.36, −1.02)	0.004

[a] Models were adjusted for sex, birth weight, maternal age, gestational age, maternal education, family income, and maternal IQ.
[b] General linear model analysis was used to see the effect of prenatal exposure on neurodevelopment at 6, 12, and 24 months.
[c] General estimating equations were used to see the effect of prenatal exposure on neurodevelopment over the 24 months with repeated outcome measures.
[d] General estimating equations without adjusting for maternal IQ were performed on the same subanalysis group to compare the result with the previous model of sub-analysis.
[e] Total number of mothers who underwent Korean Wechsler Adult Intelligence Scale.

E. Kim et al. Prenatal exposure to PM_{10} and NO_2 and children's neurodevelopment from birth to 24 months of age: Mothers and Children's Environmental Health (MOCEH) study, Science of the Total Environment 481 (2014)

4) Air pollutant and Allergy diesease

Association of prenatal exposures to PM10 and NO2 on pneumonia, bronchitis, and bronchiolitis at 6 and 12 months of age

[a] *Model 1 was adjusted for birth weight, infant sex, gestational age, maternal age, maternal history of allergic diseases, and paternal history of allergic diseases.*
[b] *Model 2 was adjusted for birth weight, infant sex, gestational age, maternal age, maternal history of allergic diseases, paternal history of allergic diseases, maternal education, and family income.*

Period	Measures	MODEL 1[a]									MODEL 2[b]								
		Pneumonia			Bronchitis			Bronchiolitis			Pneumonia			Bronchitis			Bronchiolitis		
		n	OR	P	n	OR	P	n	OR	P	n	OR	P	n	OR	P	n	OR	P
At 6 months																			
Prenatal	PM10 indoor	128	1.002	0.86	128	1.058	0.03	128	1.007	0.41	128	1.003	0.82	128	1.087	0.02	128	1.007	0.42
	PM10 outdoor	61	0.999	0.94	61	1.014	0.39	61	0.985	0.24	56	1.001	0.96	56	1.026	0.24	56	0.959	0.08
	PM2.5 indoor	128	0.993	0.78	128	1.094	0.03	128	0.978	0.30	128	0.996	0.87	128	1.148	0.02	128	0.978	0.28
	PM2.5 outdoor	62	0.908	0.30	62	1.029	0.15	62	0.965	0.21	57	0.896	0.25	57	1.061	0.22	57	0.943	0.07
postnatal	NO2 indoor	130	0.925	0.35	130	0.987	0.87	130	1.013	0.70	114	0.898	0.25	114	1.008	0.93	114	1.014	0.71
	NO2 personal	102	0.934	0.35	102	0.971	0.68	102	1.029	0.37	92	0.917	0.30	92	0.981	0.82	92	0.897	0.19
At 12 months																			
Prenatal	PM10 indoor	114	0.988	0.33	114	1.01	0.33	114	0.998	0.82	114	0.989	0.39	114	1.01	0.31	114	0.997	0.81
	PM10 outdoor	59	0.996	0.78	59	1.014	0.34	59	0.96	0.10	54	0.992	0.70	54	1.064	0.08	54	0.918	0.14
	PM2.5 indoor	114	0.982	0.46	114	1.03	0.14	114	0.974	0.34	114	0.985	0.56	114	1.043	0.08	114	0.971	0.31
	PM2.5 outdoor	60	0.989	0.64	60	1.021	0.21	60	0.963	0.33	55	0.985	0.61	55	1.103	0.05	55	0.972	0.55
postnatal	NO2 indoor	127	0.932	0.16	127	0.976	0.65	127	1.028	0.41	112	0.94	0.25	112	0.974	0.68	112	1.052	0.18
	NO2 personal	106	0.911	0.11	106	0.983	0.74	106	1.028	0.42	94	0.917	0.08	94	0.977	0.72	94	1.088	0.06

Association of prenatal exposures to PM10 and NO2 asthma, allergic diseases, and atopic dermatitis at 6 and 12 months of age

[a] *Model 1 was adjusted for birth weight, infant sex, gestational age, maternal age, maternal history of allergic diseases, and paternal history of allergic diseases.*

[b] *Model 2 was adjusted for birth weight, infant sex, gestational age, maternal age, maternal history of allergic diseases, paternal history of allergic diseases, maternal education, and family income.*

Period	Measures	MODEL 1[a] Asthma n	OR	P	Allergic diseases n	OR	P	Atopic dermatitis n	OR	P	MODEL 2[b] Asthma n	OR	P	Allergic diseases n	OR	P	Atopic dermatitis n	OR	P
At 6 months																			
Prenatal	PM10 indoor	128	1.364	0.41	139	1.011	0.26	159	0.996	0.44	128	1.217	0.37	139	1.012	0.26	159	0.996	0.48
	PM10 outdoor	61	1.144	0.76	66	1.019	0.05	69	0.995	0.45	56	1.124	0.77	61	1.031	0.02	63	0.996	0.56
	PM2.5 indoor	128	1.532	0.20	139	1.025	0.23	159	1.009	0.42	128	0.997	0.27	139	1.029	0.20	159	0.998	0.29
	PM2.5 outdoor	62	1.194	0.73	67	1.024	0.05	70	0.994	0.56	57	1.165	0.82	62	1.035	0.02	64	0.995	0.62
postnatal	NO2 indoor	130	2.561	0.53	145	1.012	0.80	161	1.034	0.10	114	1.013	0.99	129	1.021	0.66	139	1.046	0.06
	NO2 personal	102	1.226	0.63	111	1.023	0.63	127	1.031	0.15	92	1.572	0.86	101	1.102	0.14	111	1.042	0.10
At 12 months																			
Prenatal	PM10 indoor	114	0.998	0.82	114	1.026	0.05	136	0.997	0.61	114	1.415	0.81	114	1.028	0.04	136	1.012	0.79
	PM10 outdoor	59	0.96	0.10	59	1.01	0.41	64	1	0.96	-	-	-	54	1.072	0.09	57	1.003	0.77
	PM2.5 indoor	114	0.974	0.34	114	1.014	0.61	136	0.994	0.65	-	-	-	114	1.019	0.52	136	1.003	0.86
	PM2.5 outdoor	60	0.963	0.33	60	1.015	0.34	65	1	0.97	-	-	-	55	1.077	0.04	58	1.004	0.78
postnatal	NO2 indoor	127	1.09	0.62	127	0.953	0.43	151	1.028	0.21	112	2.727	0.54	112	0.946	0.40	130	1.043	0.11
	NO2 personal	106	1.044	0.76	106	0.84	0.07	126	1.029	0.18	94	2.189	0.71	94	0.848	0.09	109	1.055	0.06

- The relationships between PM2.5 and house dust mite allergen or eosinophil number in group of case-control

Case	Crude model			Adjusted model**		
	β	se	P	β	se	P
Indoor PM2.5						
House dust mite allergen	0.29	0.13	0.03	0.30	0.13	0.03
Eosinophil number	19.60	7.54	0.02	23.93	8.95	0.02
Outdoor PM2.5						
House dust mite allergen	0.03	0.25	0.91	0.09	0.30	0.78
Eosinophil number	7.36	5.77	0.22	8.58	7.68	0.29

Control	Crude model			Adjusted model**		
	β	se	P	β	se	P
Indoor PM2.5,						
House dust mite allergen	0.08	0.13	0.54	-0.03	0.13	0.83
Eosinophil number	-0.01	2.09	1.00	-1.22	2.29	0.61
Outdoor PM2.5						
House dust mite allergen	-0.01	0.17	0.97	-0.02	0.17	0.91
Eosinophil number	-1.92	1.71	0.28	-1.99	1.75	0.28

- PM10
- VOCs/HCHO

1) TVOCs/HCHO and Pregnancy Outcome

- Associations between TVOC and HCHO exposure and birth weight

Birth weight (g)	Crude model			Model 1‡		
	β	SE	P	β	SE	P
TVOC(log)	-30.13	21.25	0.16	-45.89	22.36	0.04*
HCHO(log)	-11.21	36.43	0.76	-37.98	39.55	0.34

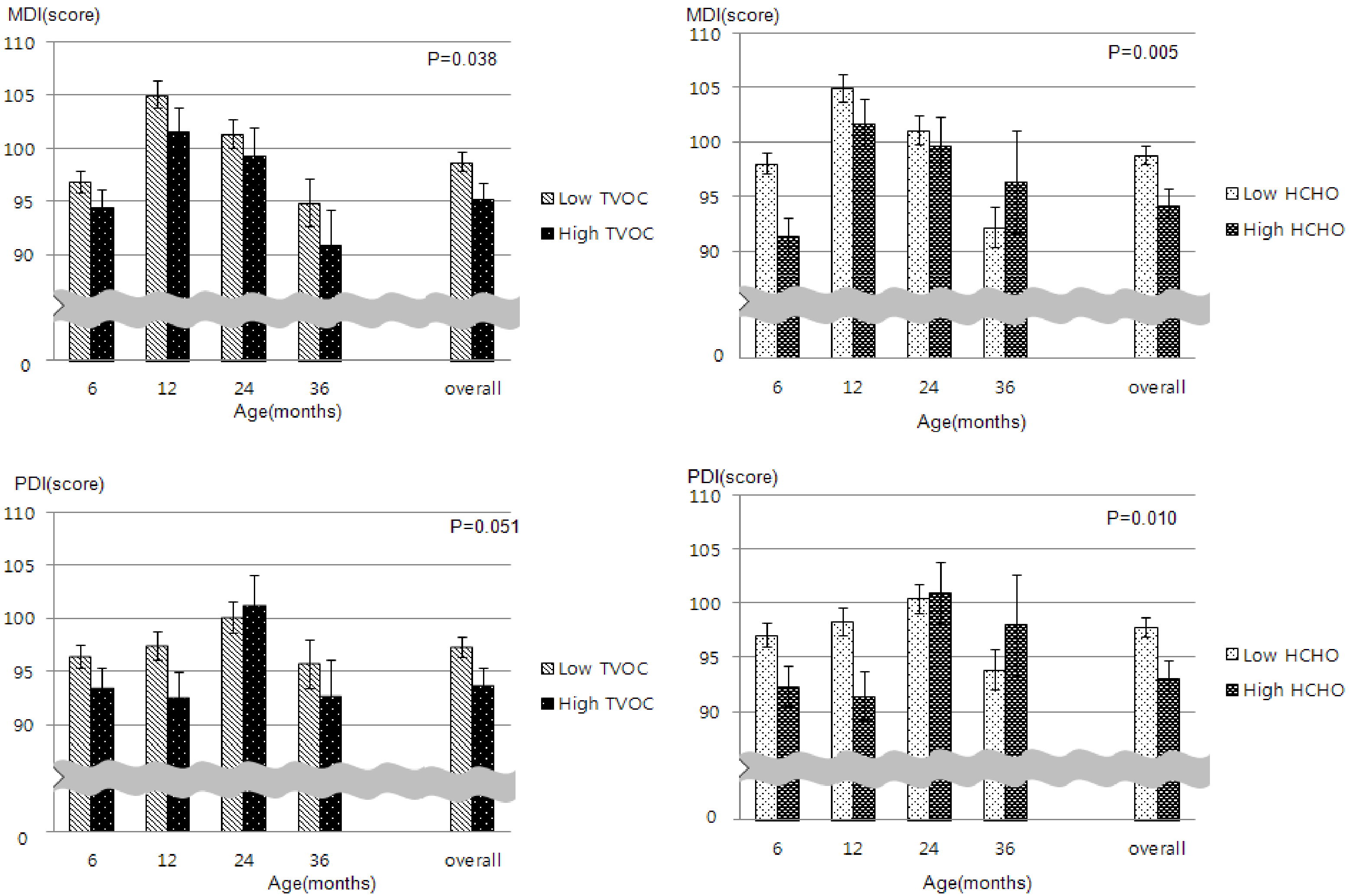
*P<0.05

†Adjusted for maternal age, gestational age at delivery, pre pregnancy BMI, educational level, birth order, and infant's gender.

‡A adjusted for plus,

separated kitchen (TVOC); air cleaner and house age (HCHO).

2) Associations between ambient personal TVOC exposure during pregnancy and neuro-behavioral development(BSID-II) in infants



3) Indoor total volatile organic compounds exposure at 6 months followed by atopic dermatitis

Table 4 Associations between the level of total VOC exposure and atopic dermatitis

VOCs exposure	No. of total subjects	No. of atopic dermatitis	Unadjusted analysis odd ratio (95% CI)	Adjusted analysis odd ratio (95% CI)
Low TVOCs (<75th) group	71	20 (27.8%)	1.0	1.0
High TVOCs (≥75th) group	34	16 (48.5%)	2.447 (1.010–5.757)	3.116 (1.041–9.323)

These odds ratios and 95% CIs adjusted for allergy history of parents, household income, and breastfed longer than 6 month.
VOCs, volatile organic compounds.
High and low VOCs divided by upper 75% of the VOCs distribution of the study subjects (242.1 μg/m^3).

Pediatric Allergy and Immunology 26 (2015) 352–358

Guidelines

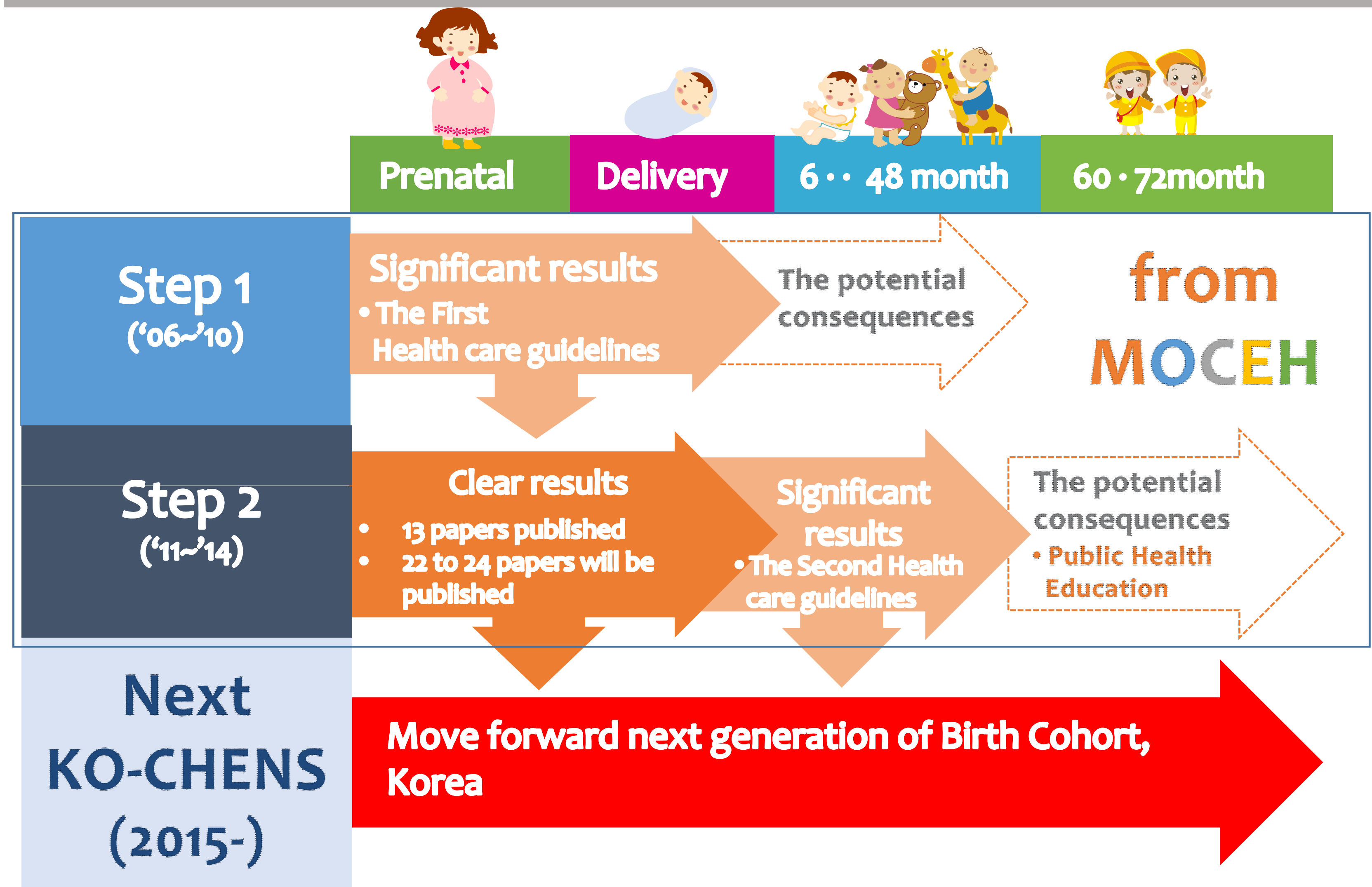
Booklets

Application

Pamplet

Postcard

Linkage of existing research and national initiatives

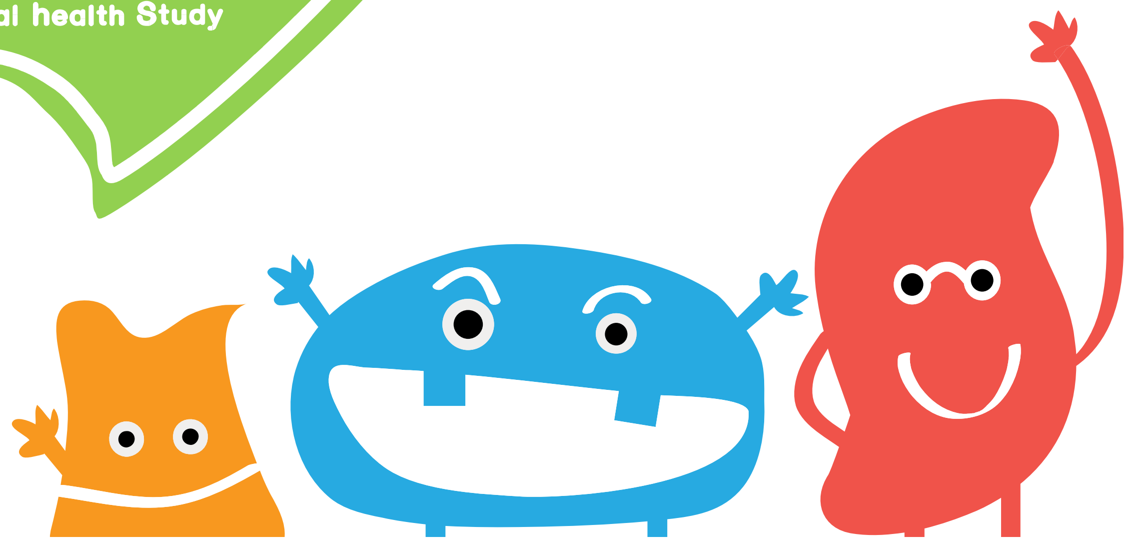


어린이환경보건출생코호트
Korean CHildren's ENvironmental health Study

Korean CHildren's ENvironmental health Study

Hello!!
We are Koby, Chenchen, and Stu !
Let us introduce our study

KO-CHENS!
Korean CHildren's
ENvironmental health Study



An introduction to Ko-CHENS!

- Korean CHildren's ENvironmental health Study (Ko-CHENS) is a long-term prospective pregnancy and children cohort study which is planning to include approximately 100,000 pregnancies in the years between 2015 and 2019.

- The study includes the prenatal period up to an age of 18 years and follow-up activities for monitored children into adulthood using biological samples and questionnaires focused on environmental exposures.

MINISTRY OF ENVIRONMENT

National Institute of Environmental Research

Ko-CHENS! Study Design

- Ko-CHENS will use two data collection methods; Main study and Core study.

	Main study	Core study
Study period	2015~2036 (22years, from the prenatal period until the age of 18)	
Recruitment period	2015~2019 (5years)	2015~2017 (3years)
Target participants	65,000 pregnant women	5,000 pregnant women
Recruiting Institute	Public health care centers /Obstetric units in the hospitals	Obstetric units in the hospitals / Public health care centers
Follow-up period	Through linkage to national health registries	20 years through hospital visits

Join Ko-CHENS NOW!

Participant requirement

All pregnant women (Main study) / Pregnant women at less than 20 weeks of gestation (Core study)

Way to Register

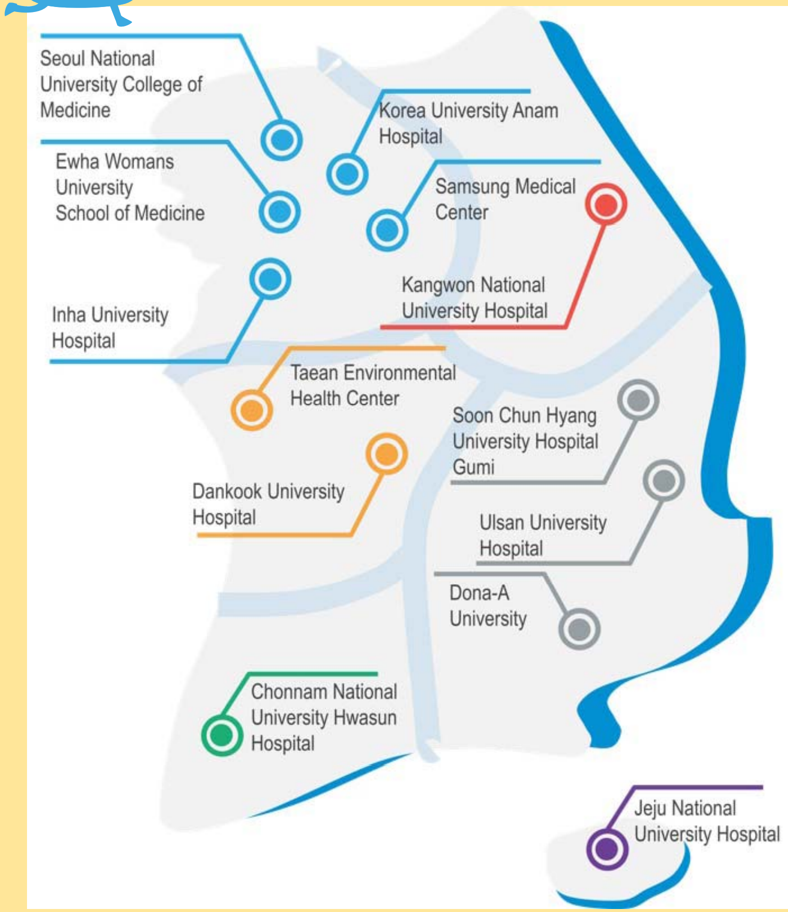
You can join Ko-CHENS at designated hospitals and centers

Questions about registration

Information of designated centers, website, hotline of Ko-CHENS are at the bottom

Official website : cafe.naver.com/environmentforchild
Mobile ver. Website : environmentforchild.modoo.at
Official hotline : 1544-6701

Map of Study Locations

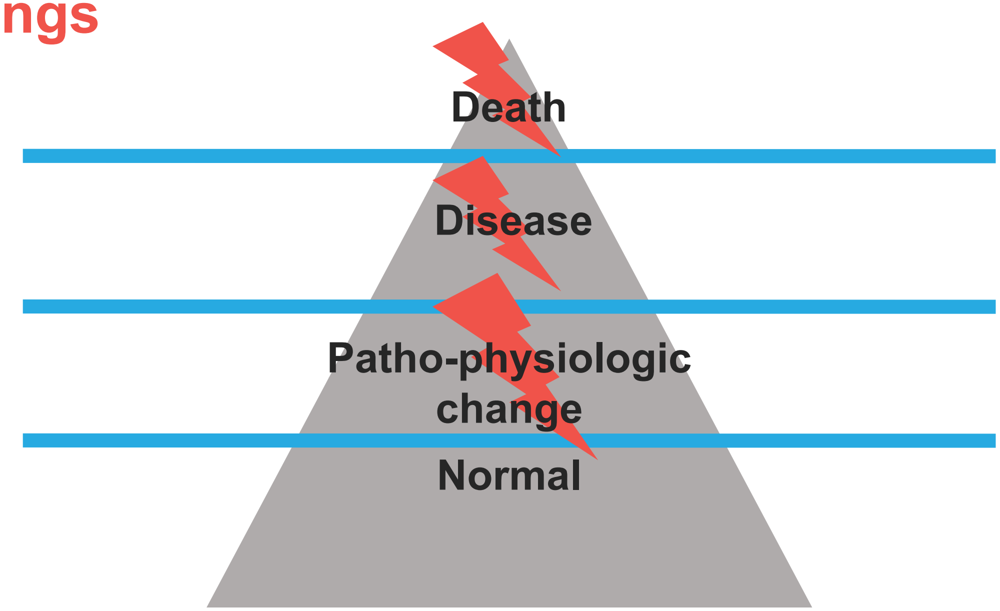


V. Conclusion

1. Is it really that ambient air pollution is a risky?

- "YES"
- "Consistent" and "coherent" findings

- "Consistent findings" over
  - areas/cities/countries
  - populations
  - study designs



2. Who are in danger?

- Children and the elderly
- Persons having a chronic disease

3. What else do we need to pursue?

- Physico-chemical characteristics of particles
- Accountability
- Reduction strategies of adverse health effects from air pollution exposure

- # What is "Precautionary Principle"?

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"We must act on facts, and on the most accurate interpretation of them, using the best scientific information. That does not mean that we must sit back until we have 100% evidence about everything. Where the state of the health of the people is at stake, the risks can be so high and the costs of corrective action so great, that prevention is better than cure. We must analyze the possible benefits and costs of action and inaction. ***<u>Where there are significant risks of damage to the public health, we should be prepared to take action to diminish those risks, even when the scientific knowledge is not conclusive</u>****, if the balance of likely costs and benefits justifies it."*

(Horton R. The new public health of risk and radical engagement. Lancet 1998;352:251-2)

Ko-CHENS!

어린이환경보건출생코호트

Korean CHildren's ENvironmental health Study

Thank you