Abstract

Quantitative health risk assessment achieved to presume benefit from improving PM10 and PM2.5 quality in this research, and willingness to pay amount of local residents estimated to calculate a value of statistical life. To evaluate the relationship between PM exposure and daily mortality, we studied time-series analysis of them. The association of PM10/PM2.5 with daily mortality was examined in Seoul, during the period of 2004~2005. Generalized additive Poisson models controlling for confounders were used to evaluate the acute effects of particle exposures on total, respiratory, and cardiovascular mortality. PM10 caused more than 306 of all-cause mortality per year and 92 / 282 of respiratory mortality and cardiovascular mortality, respectively. And PM2.5 caused more than 1,488 of all-cause mortality per year and 146 / 486 of respiratory mortality and cardiovascular mortality, respectively. The monthly average WTP for 5/1,000 mortality reduction over ten years was $25.3(2007$) per month and the implied value-of-statistical-life (VSL) was 0.61 million dollar per year. We combined the annual attributable number of death and the value of statistical life to calculate the damage cost. The total damage cost of PM10 in ambient air was 186.9 million dollar and total damage cost of PM2.5 was 907.7 million dollar.

Particulate Size-based Health Damage Cost Of Acute Mortality

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Methodology

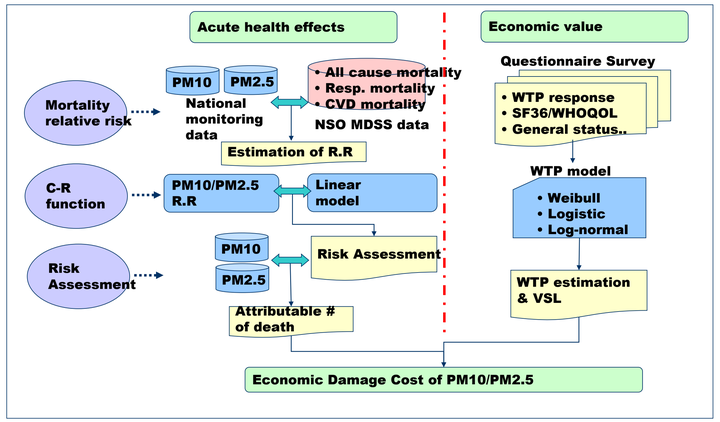
In assessing the acute health effects, we used Korea NSO mortality data and National and Seoul monitoring data for estimating the RR of PM.

After that, we derived the C-R function using the RR in Linear model and assess the attributable # of death.

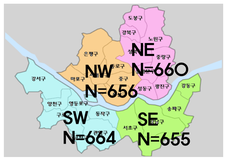
For valuing the statistical life due to air pollution, we developed WTP questionnaire and carried our the survey with 26 hundred people living in Seoul.

And we modeled that results in three different distribution model and evaluated the WTP and VSL of air pollution risk change.

In final part of our study, we combined the annual attributable # of death count and value of statistical life to calculate the damage cost of PM exposure.



< PM Monitoring station>



< WTP Questionnaire survey>

PM data Source

PM10 : National Monitoring data (2004-2005)

PM2.5 : Seoul Metropolitan City Monitoring data (2004-2005)

Methodology

• Mortality data & etc.

-Source : Korea NSO MDSS (Micro Data Service System)
-Variables : date at death, address, age, sex, cause of death (in ICD-10 code)
-Cause of death
All cause : All cause except for car accident, suicide etc. (ICD-10 V01-Y89)
Respiratory : Total respiratory mortality (J00-J98)
Cardiovascular : Total cardiovascular mortality (I00-I99)
-Etc.
Meteorological data : daily temp. & humidity
# of Exposure population : population & housing census

•Modeling PM ∽ mortality

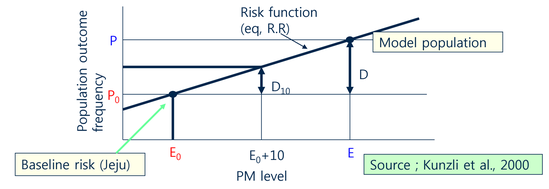
- **Generalized Additive Model**
- **Semi-parametric log-linear Poisson model**

$$\log(\mu_t) = x_t\alpha + f_t^1 + \cdots + f_t^k$$

x = Air Pollutant

f^i = LOWESS of trend, weather or other air pollutants

•C-R function (Kunzli model)



$P = (P_{ij} - P_{0ij}) \times EP / 1{,}000{,}000$ ..... eq. 1

Where, P = # of premature death

P_{ij} = PM Conc. x D_{10ij} x 0.1 + [P_{0ij} - (E_{0i} x D_{10ij} x 0.1)]

D_{10ij} = (RR - 1) x P_{0ij}

RR = relative risk

P_{0ij} = Mortality in baseline exposure per million person

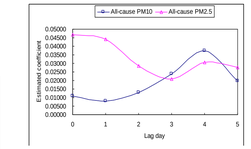
EP = Exposure population

Results

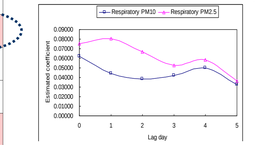
• Mortality relative risk of PM

Exposure day	All-cause		Respiratory		Cardiovascular	
	PM10†	PM2.5‡	PM10	PM2.5	PM10	PM2.5
0	1.008 (0.985-1.050)	1.038 (0.849-1.058)	1.068* (1.016-1.096)	1.082 (0.999-1.106)	1.056 (0.796-1.089)	1.044 (0.910-1.098)
1	1.004 (1.000-1.015)	1.045* (1.021-1.065)	1.054 (0.985-1.089)	1.083* (1.001-1.156)	1.055 (0.989-1.087)	1.056 (0.877-1.086)
2	1.003 (0.987-1.023)	1.033 (0.998-1.088)	1.049 (0.918-1.096)	1.068 (0.849-1.079)	1.049 (0.997-1.098)	1.048* (1.021-1.078)
3	1.005* (1.001-1.016)	1.029 (0.949-1.094)	1.033 (0.981-1.096)	1.055 (0.971-1.084)	1.032* (1.009-1.099)	1.032 (0.881-1.095)
4	1.007 (0.994-1.020)	1.022 (0.855-1.085)	1.045 (0.962-1.087)	1.048* (1.022-1.098)	1.038* (1.010-1.084)	1.021 (0.954-1.038)
5	1.001 (0.849-1.061)	1.018 (0.956-1.059)	1.029 (0.894-1.088)	1.039* (1.008-1.098)	1.019 (0.997-1.065)	1.020* (1.008-1.049)

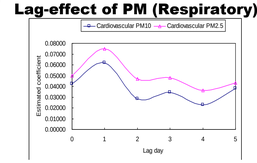
†PM10 IQR = 39.7㎍/㎥ / ‡PM2.5 IQR = 22.7㎍/㎥ / * p < 0.05
number in parenthesis is 95% CI



Lag-effect of PM (All-cause)

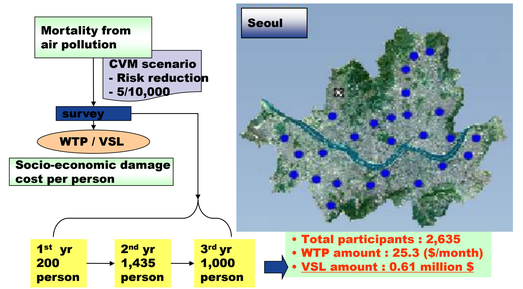


Lag-effect of PM (Respiratory)



Lag-effect of PM (Cardiovascular)

•Willingness-to-pay & Value of Statistical Life



• Damage cost due to PM

	PM10			PM2.5		
	All-cause	Resp.	CVD	All-cause	Resp.	CVD
# of Death (person)	306.41	91.56	282.20	1488.06	145.68	485.70
Damage Cost (million $)	186.9	55.9	172.1	907.7	88.9	296.3

The relative risk of PM10 was less than PM2.5 and the value of statistical life was 0.61 million$ in Seoul. For all cause mortality, the damage cost of current PM10 exposure was 187 million$ in Seoul and PM2.5 was 908 million$. In our opinion, the benefits of PM2.5 criteria establishment may be greater than reducing the PM10 criteria.