Issues Associated with Epidemiology Studies on PM2.5 in Taiwan

Wen-Chao Ho[1], Meng-Hung Lin[1], Hwa-Lung Yu[2], Hsien-Ho Lin[3], Kuen-Yuh Wu[4] , Pau-Chung Chen[4], Tsun-Jen Cheng[4]

[1]Department of Public Health, China Medical University, Taichung, Taiwan,
[2]Department of Bioenvironmental Systems Engineering, National Taiwan University, Taipei, Taiwan,
[3]Graduate Institute of Epidemiology and Prevention Medicine, National Taiwan University, Taipei, Taiwan,
[4]Institute of Occupational Medicine and Industrial Hygiene, National Taiwan University, Taipei, Taiwan.

Content

- Background
- Objective
- First Year Brief Summary (Methods, Analysis Steps, and Results)
- On-going Second Year Study
- Further

Background

- In recent years, Taiwan EPA air quality monitoring station data show that there is an improving trend in air quality, but the particles (particular matter, PM) concentration compared with the standard value is still high.
- The impact of fine particle ($PM_{2.5}$) on the environment and human health is more widely concerned recently.
- Although the health effects of suspended particles have been studied, fine particle ($PM_{2.5}$) is not well assessed.

Objective

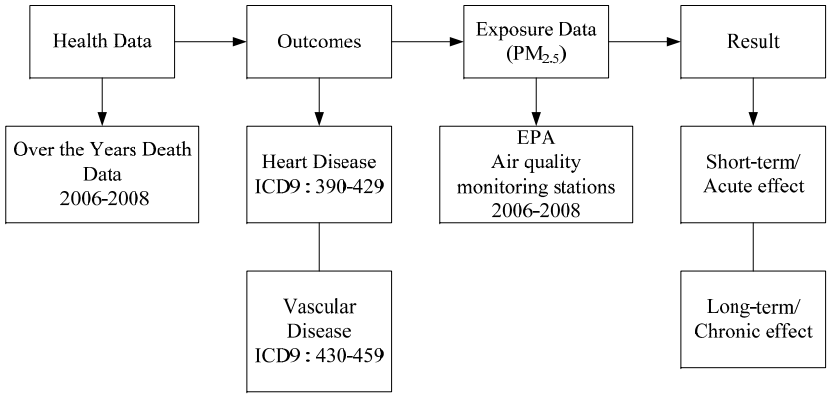
- Exposure assessment of fine particle ($PM_{2.5}$).
- Assessing the health effects of short-term and long-term fine particle ($PM_{2.5}$) exposure on the cardiovascular diseases mortality and morbidity.

First Year Brief Summary

- Methods
- Analysis Steps
- Results

Methods

Research framework：



Methods (cont.)

The main sources of the database include:

1. **Air pollution data**: Hourly air pollution data were collected by using air monitoring stations from Taiwan EPA during 2006-2008.

2. **Death registration database**: Mortality data were collected from death registry system in Taiwan during 2006-2008.

Analysis steps

- Study database: Death registration database from Department of Health
- Study period: 2006-2008
- Study area: The townships which have air quality stations, total 64 townships.
- Units of study period:
  - Long term： Cardiovascular diseases mortality per month in study area during 2006-20008.
  - Short term：Using case-crossover design, lag periods were 1, 2, 3, 7 days, and the same week date of lag periods within one month as the control group (1:4 matching)
- Statistical Methods：
  - Long term： Repeated-Poisson regression
  - Short term： Conditional logistic regression
- Controlling risk factors: sex, age, degree of urbanization, density of cardiology physicians, temperature, and humidity.

Results

Figure 1. Air quality monitoring network in Taiwan

Results (cont.)

Table 1. Descriptive statistics of monthly average values from sixty-four air monitoring stations in Taiwan, 2006-2008.

	Pollutant	N	Mean	Minimum	Maximum	IQR	percentile 25th	50th	75th
Monthly	$PM_{2.5}$, μg/m³	2302	34.87	9.31	94.71	18.93	24.07	31.99	43.00
	SO_2, ppb	2304	4.79	1.36	19.80	2.15	3.32	4.31	5.47
	NO_2, ppb	2304	18.36	3.19	46.47	10.32	12.89	17.46	23.21
	CO, ppb	2304	0.52	0.14	1.56	0.25	0.38	0.49	0.63
	O_3, ppm	2300	28.96	12.51	58.92	10.00	23.63	28.23	33.63
	Temperature, ℃	2282	23.9	11.53	32.49	8.02	19.89	24.77	27.91
	Relative Humidity, %	2281	74.2	57.64	88.95	6.31	71.00	73.97	77.31
Daily	$PM_{2.5}$, μg/m³	66696	34.76	0.25	176.94	27.66	19.13	29.75	46.79
	SO_2, ppb	69032	4.79	0.28	52.58	3.04	2.78	3.99	5.82
	NO_2, ppb	68726	18.38	0.33	80.93	12.46	11.47	17.00	23.93
	CO, ppb	69320	0.52	0.03	3.01	0.30	0.34	0.48	0.64
	O_3, ppm	69091	28.95	2.32	94.26	15.51	20.46	27.49	35.98
	Temperature, ℃	68726	23.92	6.40	34.88	7.88	20.17	24.85	28.05
	Relative Humidity, %	68647	74.19	0.11	99.95	10.93	68.80	74.13	79.72

Results (cont.)

Table 2. Correlation coefficient of monthly and daily average concentrations.

		$PM_{2.5}$	SO_2	NO_2	CO	O_3
Monthly	$PM_{2.5}$	1	0.48	0.53	0.44	0.23
	SO_2		1	0.58	0.40	-0.06
	NO_2			1	0.88	-0.27
	CO				1	-0.27
	O_3					1
Daily	$PM_{2.5}$	1	0.45	0.52	0.5	0.33
	SO_2		1	0.54	0.4	0.02
	NO_2			1	0.84	-0.17
	CO				1	-0.14
	O_3					1

Results (cont.)

Table 3. Adjusted RR* for disease specific mortality in single-pollutant model† using Poisson regression in Taiwan, 2006-2008.

Pollutant	Diseases (RR, 95% CI) All death cause	ICD9=390-459 Cardiovascular disease	ICD9=401-405 Hypertensive disease	ICD9=410-414 Ischemic heart disease	ICD9=430-438 Cerebrovascular disease	ICD9=460-519 Respiratory disease	ICD9=480-488 Pneumonia and Influenze	ICD9=490-496 COPD
All Season								
$PM_{2.5}$	1.05 (1.02-1.07)	0.97 (0.94-0.99)	1.06 (0.95-1.19)	1.00 (0.95-1.05)	0.92 (0.88-0.95)	1.09 (1.05-1.14)	1.17 (1.10-1.24)	1.07 (1.01-1.13)
SO_2	1.01 (0.99-1.02)	0.97 (0.96-0.99)	1.01 (0.93-1.10)	0.98 (0.95-1.01)	0.98 (0.95-1.00)	1.02 (0.98-1.05)	0.99 (0.95-1.04)	1.05 (1.02-1.09)
NO_2	0.96 (0.94-0.99)	0.94 (0.91-0.97)	0.91 (0.79-1.05)	0.97 (0.91-1.03)	0.92 (0.88-0.97)	0.96 (0.91-1.01)	0.93 (0.86-1.01)	1.00 (0.92-1.08)
CO	0.97 (0.95-0.99)	0.96 (0.94-0.99)	0.96 (0.83-1.10)	0.97 (0.91-1.02)	0.97 (0.93-1.01)	0.95 (0.90-0.99)	0.91 (0.85-0.98)	1.00 (0.94-1.05)
O_3	1.05 (1.03-1.07)	1.04 (1.01-1.06)	1.03 (0.91-1.17)	1.03 (0.98-1.09)	1.01 (0.98-1.06)	1.09 (1.04-1.14)	1.11 (1.05-1.16)	1.03 (0.96-1.12)
Warm Season								
$PM_{2.5}$	1.04 (1.02-1.07)	0.95 (0.91-0.99)	1.11 (0.95-1.30)	0.97 (0.90-1.04)	0.89 (0.84-0.93)	1.11 (1.05-1.17)	1.15 (0.99-1.33)	1.38 (1.17-1.64)
SO_2	1.01 (0.99-1.03)	0.96 (0.94-0.98)	1.04 (0.93-1.15)	0.97 (0.93-1.01)	0.96 (0.92-0.99)	1.03 (0.98-1.09)	1.00 (0.94-1.07)	1.08 (1.03-1.13)
NO_2	0.95 (0.92-0.98)	0.92 (0.89-0.96)	0.92 (0.80-1.06)	0.92 (0.85-1.00)	0.91 (0.86-0.97)	0.95 (0.89-1.02)	0.91 (0.83-1.01)	0.97 (0.88-1.08)
CO	0.97 (0.95-0.98)	0.96 (0.94-0.98)	0.98 (0.89-1.08)	0.94 (0.89-1.00)	0.97 (0.92-1.02)	0.95 (0.91-1.00)	0.91 (0.85-0.98)	1.00 (0.95-1.06)
O_3	1.06 (1.04-1.08)	1.05 (1.03-1.07)	1.10 (0.99-1.23)	1.07 (1.01-1.14)	1.02 (0.98-1.07)	1.08 (1.03-1.14)	1.10 (1.04-1.16)	1.04 (0.96-1.13)
Cool Season								
$PM_{2.5}$	1.07 (1.04-1.09)	1.01 (0.97-1.05)	1.16 (1.02-1.32)	1.05 (0.98-1.12)	0.98 (0.92-1.03)	1.10 (1.04-1.16)	1.17 (1.07-1.28)	1.09 (1.00-1.19)
SO_2	1.00 (0.99-1.02)	0.99 (0.97-1.01)	1.02 (0.93-1.11)	1.00 (0.97-1.03)	1.01 (0.99-1.03)	1.00 (0.97-1.03)	0.98 (0.93-1.03)	1.03 (0.99-1.09)
NO_2	0.95 (0.92-0.98)	0.97 (0.93-1.01)	1.00 (0.80-1.25)	1.03 (0.96-1.11)	0.97 (0.91-1.03)	0.94 (0.88-1.01)	0.91 (0.83-1.01)	1.03 (0.92-1.15)
CO	0.97 (0.94-1.00)	0.98 (0.94-1.02)	0.98 (0.73-1.31)	1.03 (0.96-1.09)	0.99 (0.94-1.05)	0.91 (0.85-0.97)	0.89 (0.80-0.98)	0.97 (0.87-1.08)
O_3	1.05 (1.01-1.08)	1.04 (0.99-1.10)	0.99 (0.80-1.22)	0.97 (0.89-1.06)	1.04 (0.97-1.11)	1.10 (1.02-1.19)	1.11 (1.01-1.22)	1.02 (0.90-1.15)

* RR calculated for an interquartile range increases of $PM_{2.5}$ (18.93 μg/m³), SO_2 (2.15 ppb), NO_2 (10.32 ppb), CO (0.25 ppm), and O_3 (10.00 ppb).

† All models adjusted by gender, age, season, urbanization, medical resources, temperature and relative humidity.

Results (cont.)

Table 4. Adjusted RR* for disease specific mortality in two-pollutant model† using Poisson regression in Taiwan, 2006-2008.

Model	Diseases (RR, 95% CI)							
	All death cause	ICD9=390-459 Cardiovascular disease	ICD9=401-405 Hypertensive disease	ICD9=410-414 Ischemic heart disease	ICD9=430-438 Cerebrovascular disease	ICD9=460-519 Respiratory disease	ICD9=480-488 Pneumonia and Influenze	ICD9=490-496 COPD
All Season								
$PM_{2.5}$ with SO_2	1.05 (1.03-1.07)	0.99 (0.96-1.01)	1.07 (0.95-1.20)	1.01 (0.96-1.07)	0.92 (0.88-0.95)	1.09 (0.99-1.19)	1.19 (1.05-1.35)	1.03 (0.92-1.16)
$PM_{2.5}$ with NO_2	1.08 (1.05-1.11)	0.99 (0.96-1.03)	1.14 (1.01-1.28)	1.01 (0.95-1.08)	0.94 (0.89-0.98)	1.08 (0.98-1.19)	1.19 (1.04-1.37)	0.99 (0.85-1.15)
$PM_{2.5}$ with CO	1.07 (1.04-1.09)	0.98 (0.95-1.01)	1.10 (0.97-1.23)	1.01 (0.96-1.07)	0.92 (0.88-0.96)	1.14 (1.02-1.28)	1.27 (1.07-1.52)	1.03 (0.86-1.23)
$PM_{2.5}$ with O_3	1.03 (1.01-1.05)	0.95 (0.92-0.98)	1.06 (0.94-1.19)	0.98 (0.94-1.03)	0.90 (0.87-0.94)	1.22 (1.06-1.41)	1.25 (1.02-1.52)	1.35 (1.11-1.65)
Warm Season								
$PM_{2.5}$ with SO_2	1.04 (1.02-1.07)	0.98 (0.94-1.02)	1.10 (0.93-1.30)	0.99 (0.92-1.07)	0.90 (0.85-0.95)	1.06 (0.94-1.19)	1.18 (1.00-1.39)	0.94 (0.80-1.11)
$PM_{2.5}$ with NO_2	1.08 (1.05-1.11)	0.98 (0.94-1.02)	1.18 (1.01-1.39)	1.00 (0.92-1.08)	0.91 (0.86-0.96)	1.03 (0.91-1.17)	1.15 (0.97-1.36)	0.92 (0.75-1.12)
$PM_{2.5}$ with CO	1.07 (1.04-1.10)	0.96 (0.92-1.00)	1.14 (0.97-1.34)	0.99 (0.92-1.07)	0.89 (0.84-0.94)	1.12 (0.99-1.27)	1.31 (1.09-1.56)	0.94 (0.74-1.20)
$PM_{2.5}$ with O_3	1.01 (0.98-1.04)	0.90 (0.86-0.94)	1.07 (0.89-1.28)	0.91 (0.85-0.98)	0.84 (0.79-0.90)	1.29 (1.04-1.60)	1.32 (0.95-1.84)	1.48 (1.06-2.06)
Cool Season								
$PM_{2.5}$ with SO_2	1.08 (1.05-1.10)	1.02 (0.98-1.06)	1.18 (1.03-1.35)	1.05 (0.98-1.13)	0.96 (0.90-1.03)	1.03 (0.91-1.16)	1.13 (0.92-1.38)	1.02 (0.87-1.19)
$PM_{2.5}$ with NO_2	1.09 (1.06-1.13)	1.02 (0.97-1.07)	1.19 (1.04-1.37)	1.04 (0.96-1.13)	0.98 (0.91-1.06)	1.06 (0.88-1.26)	1.20 (0.89-1.61)	1.03 (0.80-1.34)
$PM_{2.5}$ with CO	1.08 (1.05-1.11)	1.01 (0.97-1.06)	1.18 (1.03-1.34)	1.04 (0.96-1.12)	0.98 (0.91-1.04)	1.06 (0.86-1.31)	1.18 (0.82-1.71)	1.03 (0.76-1.40)
$PM_{2.5}$ with O_3	1.07 (1.04-1.09)	1.01 (0.97-1.05)	1.16 (1.02-1.32)	1.05 (0.98-1.12)	0.98 (0.92-1.03)	1.38 (1.12-1.70)	1.43 (1.02-1.99)	1.49 (1.10-2.03)

* RR calculated for an interquartile range increases of $PM_{2.5}$ (18.93 μg/m³), SO_2 (2.15 ppb), NO_2 (10.32 ppb), CO (0.25 ppm), and O_3 (10.00 ppb).
† All models adjusted by gender, age, season, urbanization, medical resources, temperature and relative humidity.

Results (cont.)

Table 5. Summary of health impact of fine particle ($PM_{2.5}$) on cardiovascular disease, respiratory disease and all death cause in Taiwan (including Taipei, Taichung and Kaohsiung City).

season	Area	Diseases (OR, 95% CI)							
		All death cause	ICD9=390-459 Cardiovascular disease	ICD9=401-405 Hypertensive disease	ICD9=410-414 Ischemic heart disease	ICD9=430-438 Cerebrovascular disease	ICD9=460-519 Respiratory disease	ICD9=480-488 Pneumonia and Influenze	ICD9=490-496 COPD
Long term (RR)									
All season	Taipei	1.04 (1.01-1.07)	1.06 (1.03-1.10)	0.89 (0.78-1.01)	1.02 (0.95-1.10)	1.12 (1.05-1.18)	1.09 (1.02-1.17)	1.14 (1.07-1.23)	0.96 (0.86-1.07)
	Taichung	1.02 (1.00-1.03)	1.14 (1.05-1.25)	1.13 (1.11-1.15)	1.40 (1.00-1.95)	1.13 (1.08-1.19)	1.06 (0.92-1.23)	1.00 (0.81-1.22)	1.09 (0.94-1.25)
	Kaohsiung	1.02 (0.97-1.06)	0.96 (0.87-1.05)	1.55 (0.93-2.59)	1.06 (0.82-1.39)	1.01 (0.85-1.19)	0.97 (0.82-1.15)	1.21 (0.98-1.50)	0.80 (0.63-1.01)
	Taiwan	1.08 (1.05-1.11)	0.99 (0.96-1.01)	1.14 (1.01-1.28)	1.01 (0.96-1.07)	0.94 (0.89-0.98)	1.22 (1.06-1.41)	1.27 (1.07-1.52)	1.35 (1.11-1.65)
Warm	Taipei	1.01 (0.95-1.08)	0.98 (0.94-1.02)	0.99 (0.80-1.22)	1.02 (0.96-1.09)	0.96 (0.89-1.04)	1.00 (0.89-1.13)	1.02 (0.89-1.17)	0.92 (0.78-1.09)
	Taichung	1.05 (1.04-1.05)	1.06 (0.85-1.31)	0.95 (0.61-1.46)	1.47 (0.83-2.61)	1.03 (0.97-1.10)	0.92 (0.89-0.94)	1.07 (0.69-1.66)	0.97 (0.73-1.27)
	Kaohsiung	1.02 (0.96-1.09)	1.10 (0.97-1.24)	1.96 (1.27-3.04)	1.16 (0.83-1.62)	1.02 (0.78-1.31)	0.95 (0.86-1.04)	1.25 (1.05-1.49)	1.03 (0.84-1.27)
	Taiwan	1.08 (1.05-1.11)	0.98 (0.94-1.02)	1.18 (1.01-1.39)	1.00 (0.92-1.08)	0.91 (0.86-0.96)	1.29 (1.04-1.60)	1.31 (1.09-1.56)	1.48 (1.06-2.06)
Cool	Taipei	1.07 (1.06-1.09)	1.15 (1.11-1.18)	0.85 (0.66-1.09)	1.04 (0.93-1.15)	1.25 (1.11-1.42)	1.18 (1.13-1.23)	1.29 (1.24-1.34)	0.99 (0.90-1.08)
	Taichung	0.99 (0.90-1.10)	1.34 (1.33-1.35)	1.47 (0.78-2.76)	1.45 (0.74-2.84)	1.36 (1.09-1.71)	1.31 (0.91-1.87)	1.55 (0.91-2.65)	1.13 (1.00-1.28)
	Kaohsiung	1.13 (1.03-1.23)	1.06 (0.80-1.40)	2.60 (0.95-7.15)	0.98 (0.56-1.72)	1.47 (1.06-2.04)	1.03 (0.74-1.42)	1.43 (0.95-2.15)	1.40 (0.58-3.35)
	Taiwan	1.09 (1.06-1.13)	1.02 (0.98-1.06)	1.19 (1.04-1.37)	1.05 (0.98-1.12)	0.98 (0.92-1.03)	1.38 (1.12-1.70)	1.43 (1.02-1.99)	1.49 (1.10-2.03)
Short term (OR)									
All season	Taipei	1.04 (1.02-1.06)[a]	1.07 (1.02-1.12)[a]	1.02 (0.80-1.30)[a]	1.14 (1.04-1.25)[a]	1.05 (0.97-1.13)[a]	1.07 (1.00-1.15)[a]	1.12 (1.00-1.25)[a]	1.19 (1.05-1.35)[a]
	Taichung	1.02 (0.97-1.08)[d]	1.07 (0.96-1.19)[a]	1.21 (0.88-1.68)[a]	1.37 (1.01-1.85)[a]	1.11 (0.93-1.32)[a]	1.21 (1.00-1.46)[a]	1.17 (0.90-1.52)[a]	1.33 (0.97-1.83)[a]
	Kaohsiung	1.01 (0.97-1.04)[b]	1.08 (0.96-1.21)[a]	1.46 (1.04-2.04)[b]	1.10 (0.88-1.36)[b]	1.09 (0.92-1.29)[d]	1.05 (0.91-1.23)[b]	1.11 (0.90-1.38)[d]	1.14 (0.90-1.45)[b]
	Taiwan	1.01 (1.00-1.02)[a]	1.01 (1.00-1.03)[a]	1.07 (1.01-1.14)[a]	1.01 (0.97-1.04)[a]	1.02 (0.99-1.04)[a]	1.02 (0.99-1.04)[a]	1.03 (0.99-1.06)[a]	1.03 (0.98-1.07)[a]
Warm	Taipei	1.03 (1.00-1.06)[b]	1.04 (0.97-1.11)[b]	1.03 (0.72-1.46)[b]	1.17 (1.02-1.34)[b]	1.07 (0.96-1.19)[c]	1.05 (0.95-1.16)[a]	1.14 (1.00-1.30)[c]	1.21 (1.01-1.45)[c]
	Taichung	1.05 (0.98-1.14)[d]	1.06 (0.86-1.30)[b]	1.24 (0.65-2.35)[a]	1.27 (0.85-1.89)[a]	1.18 (0.93-1.52)[d]	1.35 (1.00-1.84)[d]	1.36 (0.87-2.12)[b]	1.39 (0.85-2.26)[d]
	Kaohsiung	1.08 (1.02-1.15)[b]	1.19 (1.02-1.38)[c]	2.03 (1.25-3.29)[b]	1.36 (0.99-1.87)[a]	1.22 (0.97-1.55)[d]	1.22 (1.01-1.47)[b]	1.28 (1.02-1.61)[b]	1.26 (0.92-1.72)[b]
	Taiwan	1.02 (1.01-1.03)[b]	1.03 (1.00-1.05)[a]	1.10 (1.00-1.21)[a]	1.01 (0.96-1.07)[b]	1.05 (1.01-1.09)[a]	1.03 (0.99-1.07)[b]	1.05 (0.99-1.11)[b]	1.04 (0.98-1.11)[a]
Cool	Taipei	1.10 (1.06-1.14)[d]	1.12 (1.04-1.20)[c]	1.27 (0.94-1.70)[d]	1.16 (1.02-1.33)[c]	1.10 (0.98-1.23)[c]	1.12 (1.00-1.25)[a]	1.10 (0.94-1.29)[a]	1.40 (1.15-1.71)[c]
	Taichung	1.00 (0.93-1.07)[a]	1.08 (0.92-1.27)[a]	1.89 (1.04-3.43)[b]	1.29 (0.77-2.18)[a]	0.96 (0.74-1.25)[d]	1.34 (1.08-1.67)[a]	1.24 (0.86-1.81)[a]	1.55 (1.09-2.20)[a]
	Kaohsiung	0.96 (0.90-1.03)[d]	0.99 (0.85-1.15)[a]	1.46 (0.65-3.29)[b]	1.03 (0.73-1.44)[b]	1.16 (0.87-1.53)[c]	1.01 (0.79-1.30)[a]	1.23 (0.84-1.79)[d]	1.26 (0.80-1.97)[c]
	Taiwan	1.00 (0.98-1.01)[a]	1.01 (0.98-1.04)[b]	1.08 (0.97-1.20)[c]	1.01 (0.95-1.07)[a]	1.07 (1.03-1.12)[c]	1.02 (0.98-1.06)[d]	1.02 (0.96-1.09)[d]	1.03 (0.96-1.10)[d]

[a] lag 1, [b] lag 2, [c] lag 3, [d] lag 7

Results (cont.)

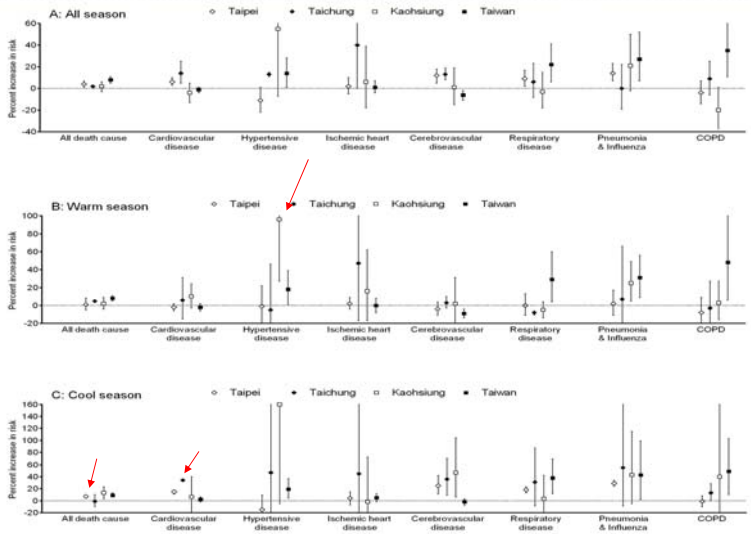


Figure2. Risk and 95% confidence interval of cardiovascular and respiratory disease mortality by increasing an inter-quartile range of fine particle ($PM_{2.5}$) monthly average concentration.

Results (cont.)

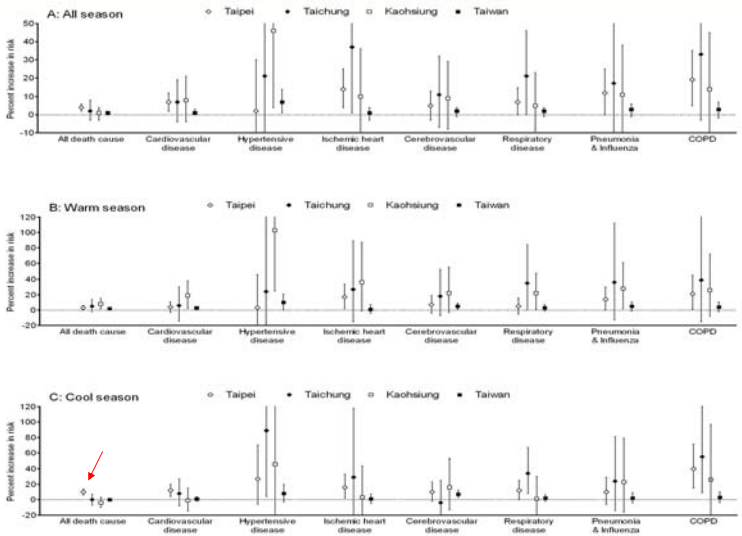


Figure 3. Risk and 95% confidence interval of cardiovascular and respiratory disease mortality by increasing an inter-quartile range of fine particle ($PM_{2.5}$) daily average concentration

Results (cont.)

- Long term effect (monthly):

  The results of fine particle related to health impact at cool season showed more consistent on all cause, cardiovascular diseases, and respiratory diseases death in Taipei city.

  Increasing an interquartile of fine particle concentration (IQR: 9.29μg/m^3) related to increasing the mortality risk of the all cause, cardiovascular diseases, and respiratory diseases, 7%, 15%, and 18% respectively.

- Short term effect (daily):

  The results also showed consistency at cool season in Taipei city. Increasing an interquartile of fine particle concentration (IQR: 18.13μg/m^3), the mortality risk was increased 10-12%.

Brief Summary of First Year Results

- The results showed more consistent in Taipei city, it could be the index city.
- There were some city-specific seasonal diseases should be consider, especially in Kaohsiung (in the warm season) and Taichung (in the cold season).
- The results of long-term (monthly average mortality) and short-term (daily average mortality) showed highly comparable.

Brief Summary of First Year Results (cont.)

WHO air quality guidelines and interim targets for fine particle: daily concentrations (μg/m^3)

	WHO	Taiwan**	
Interim target-1 (IT-1)	75	75	About increase 5% mortality over the AQG value*
Interim target-2 (IT-2)	50	50	About increase 2.5% mortality over the AQG value*
Interim target-3 (IT-3)	37.5	37.5	About increase 1.25% mortality over the AQG*
Air quality guideline (AQG)	25	25	Based on WHO and Taiwan data*

*: WHO air quality guidelines and interim targets. It is potentially consistent with the result of all cause, cardiovascular diseases and respiratory diseases mortality analyses in Taiwan
**: Taipei city may have higher relative risk, similar to the previous report (Eftim et al. 2008)

On-going Second Year Study

- Integrating fine particle (PM2.5) module simulation data, the Health Insurance data and other relevant cohort data to assess the short/ medium/ long term health impact of fine particle exposure, especially the relatively sensitive and vulnerable groups.

On-going Second Year Study (cont.)

Air Pollution (PM2.5)						
Daily Average			Monthly Average			Annual Average[1]
Health Outcomes						
Mortality[2]			Morbidity[3]			Cohort[4]
Daily：Case Crossover, Conditional logistic regression	Monthly: Repeated-Poisson regression	Annual: Repeated-Poisson regression	Daily：Case Crossover, Conditional logistic regression	Monthly: Repeated-Poisson regression	Annual: Repeated-Poisson regression	Annual: Cox Proportion Hazard Model

1. Retrospective prediction: PM2.5/PM10 and PM2.5/Ozone Ratio, and validated by superstations.
2. Data resource: Taiwan Death Registry (TDR), Department of Health (DOH).
3. Longitudinal Health Insurance Database 2005 (LHID2005).
4. Cancer Cohort Database.

Blue: Analyzed, Purple: Analyzing, Green: Going to analyze

Issues of On-going PM2.5 Epidemiology Studies

1. Air Pollution Data: PM2.5 not being available nationwide until 2005.

→ Using ratio estimation of PM2.5/PM10 and PM2.5/Ozone to fit annual average analysis models (retrospective prediction) →The ratio will be also validated by several superstations that has been starting to collect PM2.5 concentration before 2005.

Issues of On-going PM2.5 Epidemiology Studies (cont.)

2. Address: In the NHIRD, it does not provide personal address information.

→ The most frequent district of medical treatment will be used as a proxy measure of residential area of each subject.

Issues of On-going PM2.5 Epidemiology Studies (cont.)

3. Nationwide Analysis versus City-specific Analysis

→ Hierarchical Analysis and PM2.5 Component Analysis.

Issues of On-going PM2.5 Epidemiology Studies (cont.)

4. Control of Related Risk Factors →

    1. Acute: Case cross-over, self-control.

    2. Long-term: In addition to controlling social economic status, medical accessibility, environmental tobacco smoking, gender, age, related air pollutants and weather variables in the analysis of TDR and LHID2005, a prospectus cancer cohort database will be also used to assess and control further potential personal risk factors.

Further

- Long-term follow up study.
- Advancing further assessment of the recommended criteria for environment protection and environmental regulations based on Taiwan research data.
- Promoting environment protection and sustainable development for public health and welfare for all the people.

Thank you for your attention!