Effect of air pollution on daily clinic visits for respiratory disease, 1997-2000

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Outline

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Foreword

- Air quality is consistently ranked as the main environmental concern within urban communities.The quality of the air that we breathe can affect our health and well-being. Must of what we do on a daily basis impacts significantly on our air environment.

Induction

- In the passed, industrialised urban air pollution is sulphur dioxide and soot.
- The main pollutants of concern arise predominantly from motor vehicles in recent decades is nitrogen oxides, organic compounds and small particles.
- Now in some city photochemical air pollution is an important urban problem.

Jes Fenger (1999)

- The potential for air pollution at high concentrations to cause excess deaths was established in the mid-twentieth century by a series of air pollution “disasters” in the US and Europe which caused striking increases in mortality.

Hwang and Chan (2001)

* By the early 1990's, time series studies, each conducted at a single location, showed that air pollution levels, even at much lower concentrations, were associated with increased rates of mortality and morbidity in cities in the United States, Europe and other developed countries.

Hwang and Chan (2001)

- At present, although these relative rates are small, the burden of disease attributable to air pollution may be substantial considering the very large population exposed to air pollution and to whom the relative rates of mortality or morbidity apply.

Hwang and Chan (2001)

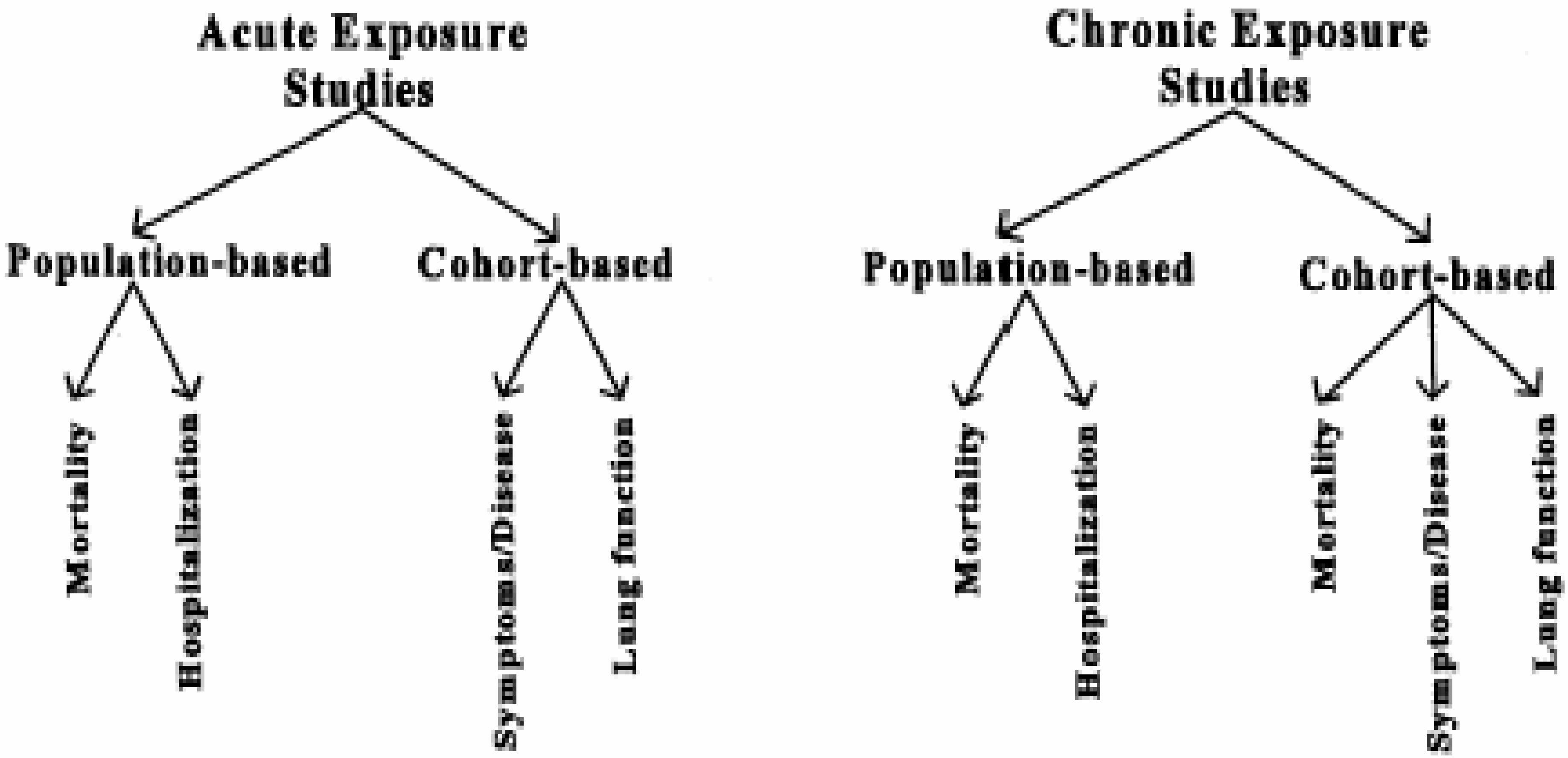

Fig. 1. Basic study designs of currently published studies of health effects of air pollution. (Pope, 1998)

Methodology

- Data collecting
- Statistical analysis

Data

- Health Data
  - based on data from the National Health Insurance Research Database provided by the Bureau of National Health Insurance, Department of Health and managed by National Health Research Institutes
  - Cases of morbidity groups were aggregated into broad categories of respiratory diseases.
  - ICD9-CM 460-519

- 醫事機構基本資料檔(HOSB)
  - 醫事機構代號(HOSP_ID)
  - 評鑑等級(HOSP_GRAD_ID)
  - 縣市區碼(AREA_NO_H)

– 門診處方及治療明細檔(CD)

- 醫事機構代號(HOSP_ID)
- 就醫日期(FUNC_DATE)
- 國際疾病分類號(ACODE_ICD9)
- 出生日期(ID_BIRTHDAY)
- 性別(ID_SEX)

Data

- Air pollution data
  - from the Environment Protection Authority (EPA)
  - 1997-2000
  - Taipei(6 stations), Taichung(2 stations), Kaohsiung(6 stations)
  - PM_{10} (24-h), O_3 (1h/4h/8h), NO_2 (1h/24h), NO (1h/24h), SO_2 (1h/24h)

Data

- Meteorological Data
  - from Central Weather Bureau
  - average temperature and relative humidity were included

Statistical analysis

- As both pollutant levels and daily morbidity may be sensitive to climate/ weather and other temporal factors such as season and long term trend in levels of pollutant and daily morbidity over time, it's important to control for these effects in the analysis.

Ostor (1995), Petroeschevsky (2001)

Statistical analysis

- Non-parameteric smoothing using Generalized Additive Models (GAM) (Hastie and Tibshirani, 1990) were used in this study
- GAM was used to confirm and test the robustness of the relationships, and the basic aim was to model temporal variations in the data in the initial step, and then address meteorological and other confounding variables in subsequent steps.

Statistical analysis

- Step 1
  - determine the smoothed function of time over the study period

- Step 2
  - Addition of temporal variables
    - day of week (6 dummy variables)
    - holiday (2 dummy variables)

- Step 3
  - Addition of meteorological variables
    - Temperature (2-day cumulative average) and relative humidity

- Step 4
  - Addition of pollutant variables using Gaussian linear regression

- Step 5
  - Seasonal investigations
    - seasonal dummy variables(cool and warm) were added to the single pollutant model to test for seasonal effects

Result

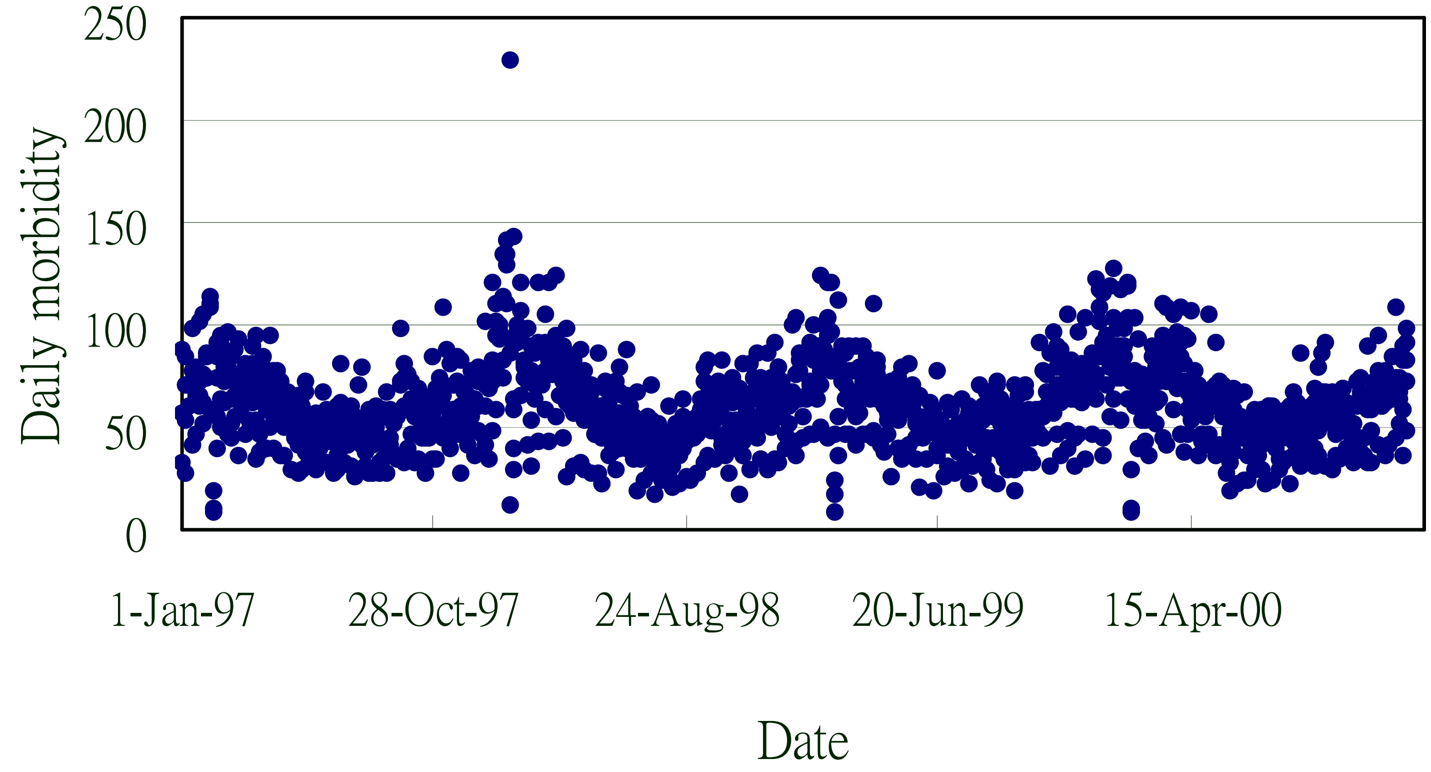

Fig 1. Time series, daily all respiratory disease, all ages, Taichung.

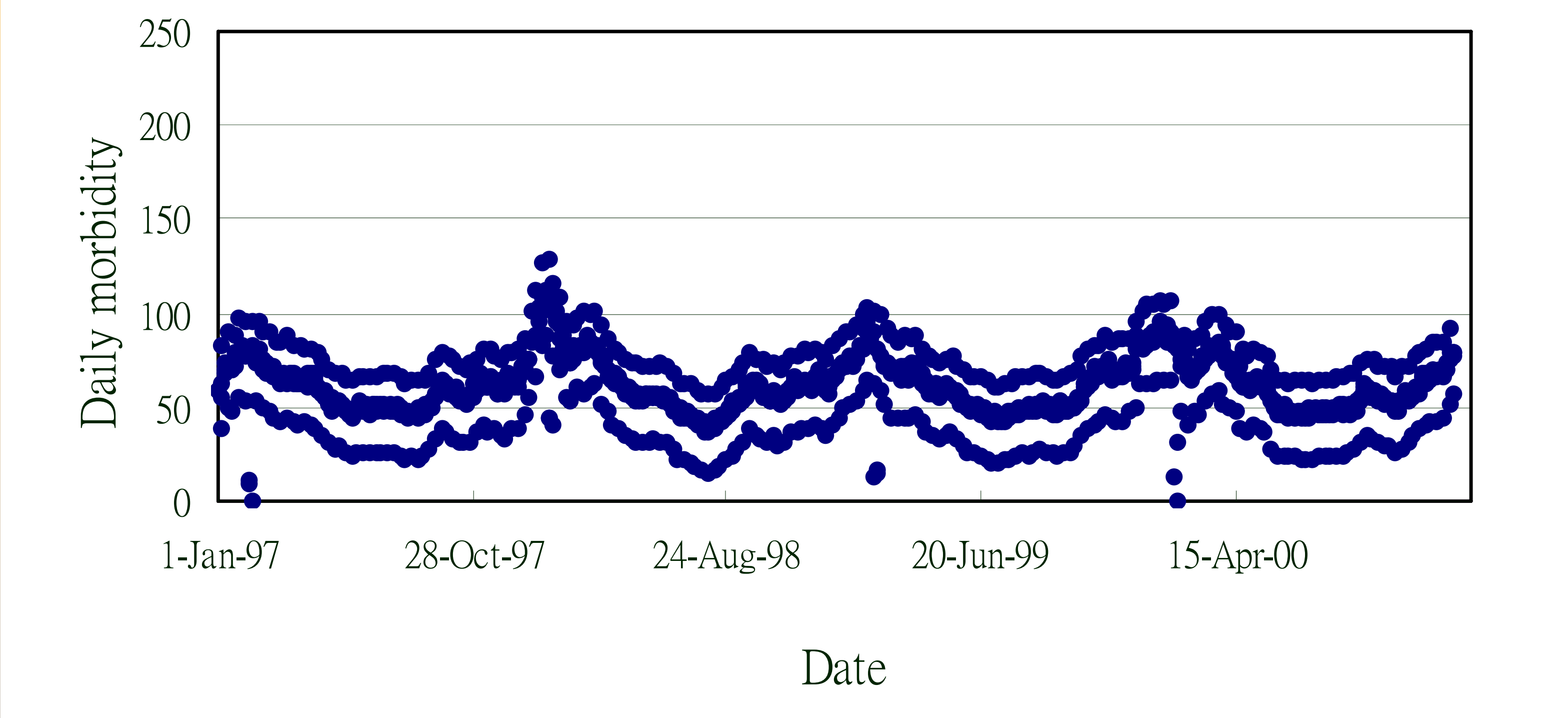

Fig. 2 Time series, the predict value for daily respiratory diseases after adding confounding factors, Taichung.

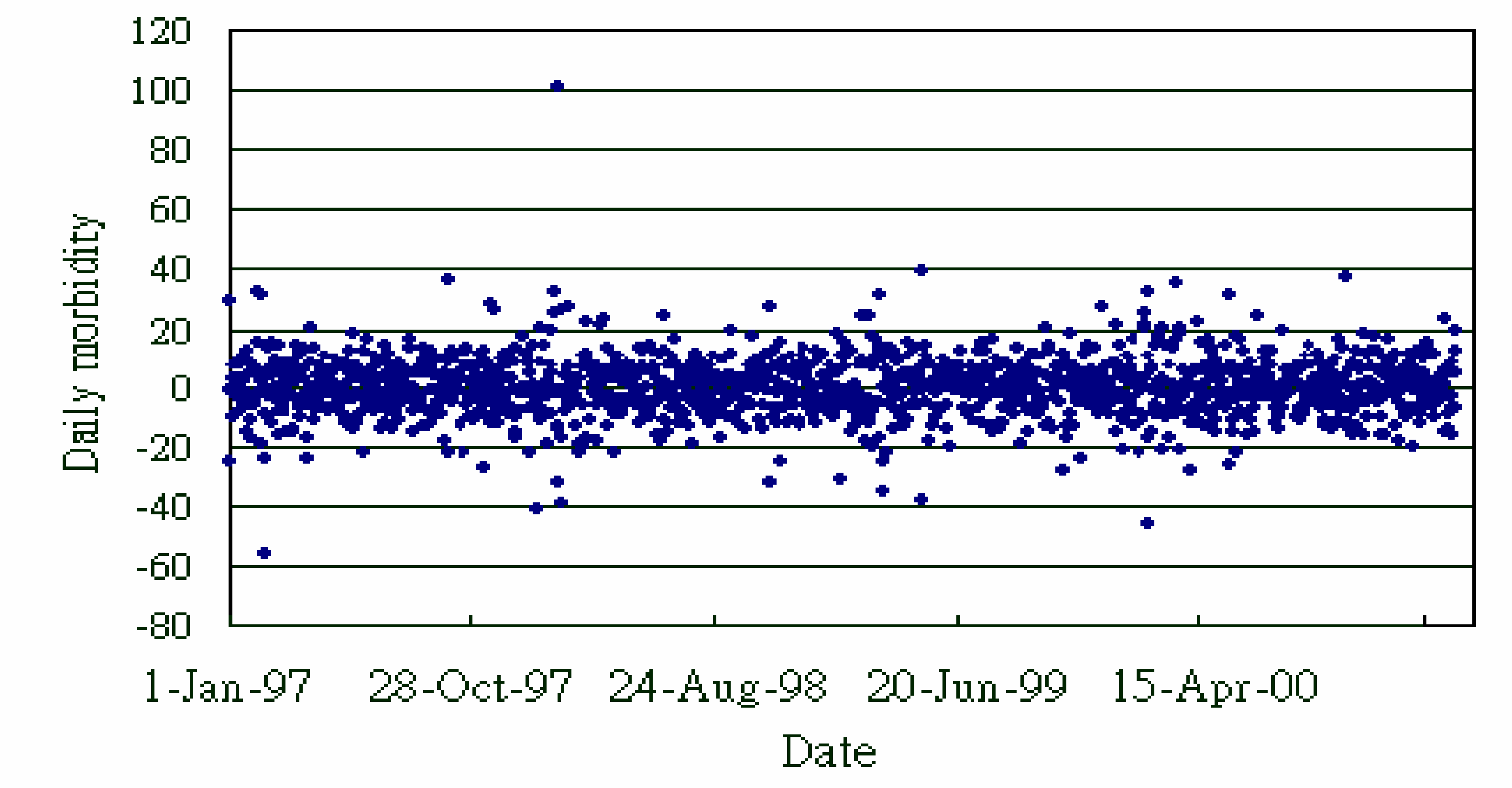

Fig. 3 Model residuals after controlling for all confounding factors.

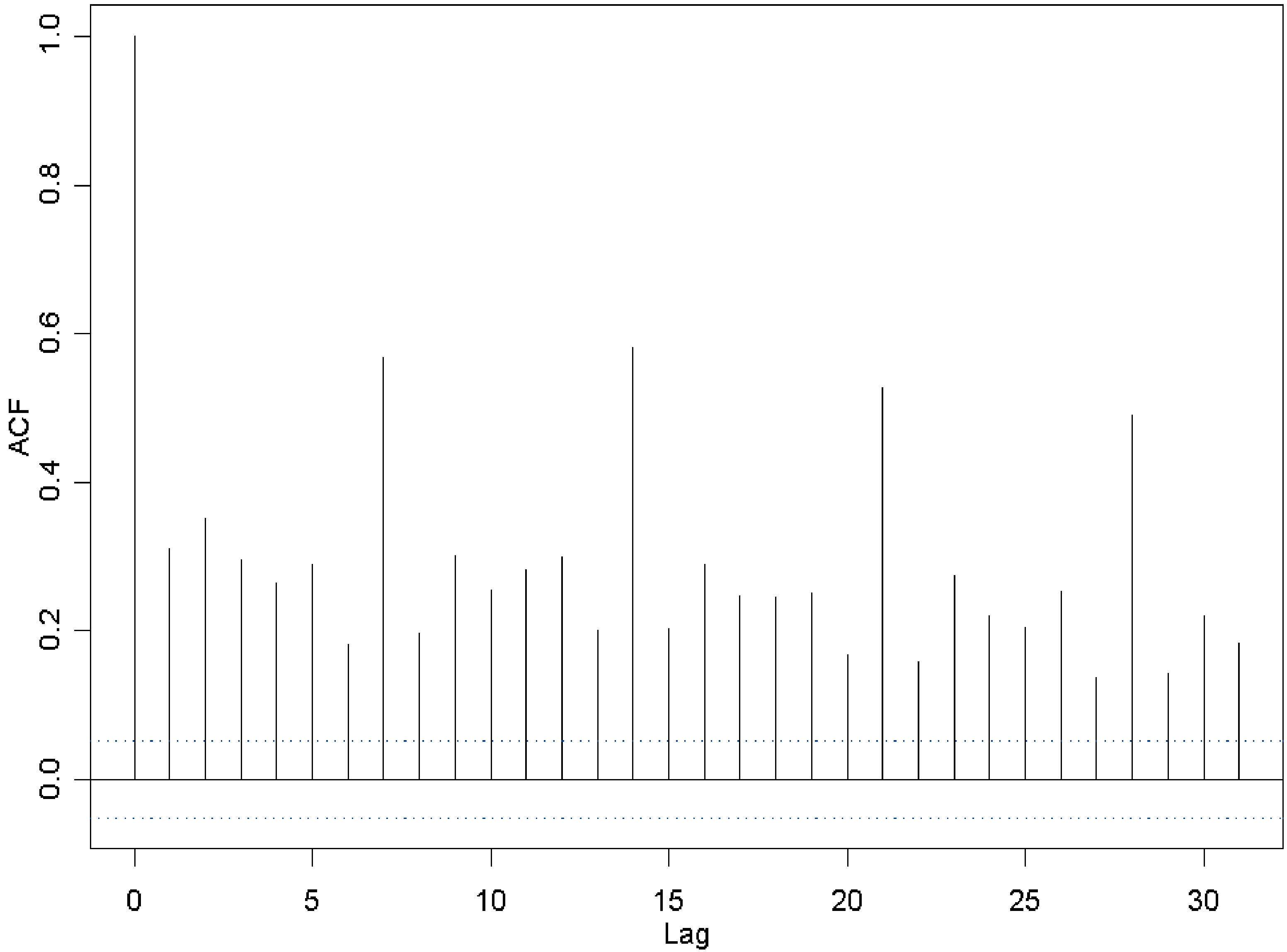

Fig. 4 The autoregression of respiratory disease from Taichung, 1997-2000.

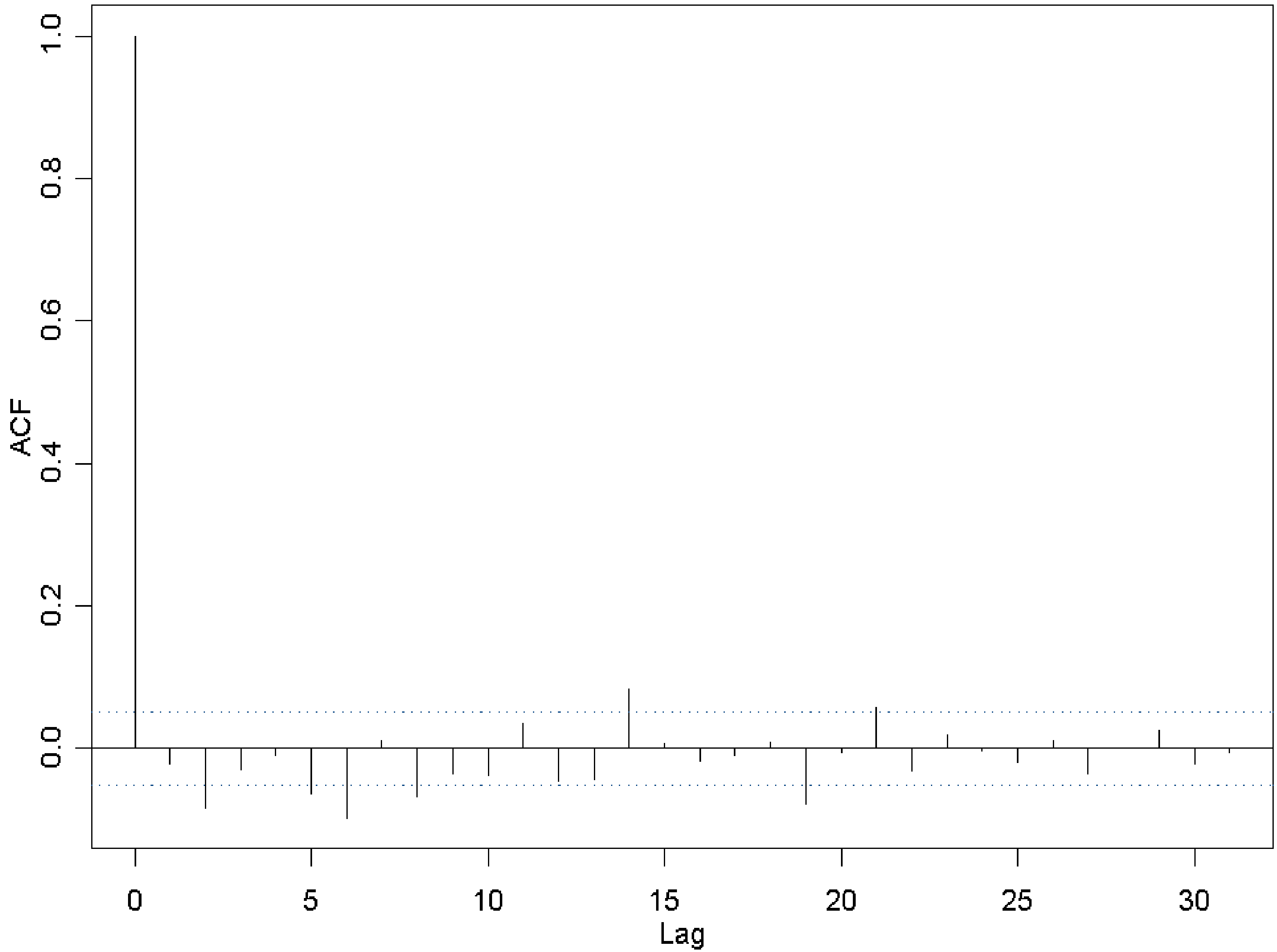

Fig. 5 The autoregression of the adjusted respiratory disease from Taichung, 1997-2000.

Table 1 Mean daily hospital admissions for respiratory disease, Taipei, 1997-2000 (n=1461)

Outcome	Cool season			Warm season			Whole study period		
	Mean (S.D.)	Min.	Max.	Mean (S.D.)	Min.	Max.	Mean (S.D.)	Min.	Max.
0-14 y	30.4 (10.8)	**2**	65	25.5 (8.4)	**6**	56	27.1 (9.5)	2	65
15-64 y	37.2 (15.5)	**1**	85	28.0 (11..0)	**4**	66	31.0 (13.4)	1	85
>64 y	6.3 (3.8)	**0**	23	5.3 (3.1)	**0**	17	5.6 (3.4)	0	23
TOTAL	73.9 (25.1)	**4**	152	58.7 (18.2)	**16**	118	63.7 (21.9)	4	152

Table 2 Mean daily hospital admissions for respiratory disease, Taichung, 1997-2000 (n=1461)

Outcome	Cool season			Warm season			Whole study period		
	Mean (S.D.)	Min.	Max.	Mean (S.D.)	Min.	Max.	Mean (S.D.)	Min.	Max.
0-14 y	**18.2 (6.9)**	**2**	**56**	**14.4 (5.6)**	**2**	**37**	**15.6 (6.3)**	**2**	**56**
15-64 y	**18.6 (7.7)**	**1**	**58**	**14.1 (5.7)**	**1**	**35**	**15.5 (6.8)**	**1**	**58**
>64 y	**2.4 (1.8)**	**0**	**10**	**2.0 (1.6)**	**0**	**9**	**2.2 (1.7)**	**0**	**10**
TOTAL	**39.2 (13.1)**	**4**	**118**	**30.4 (9.9)**	**8**	**80**	**33.3 (11..8)**	**4**	**118**

Table 3 Mean daily hospital admissions for respiratory disease, Kaohsiung, 1997-2000 (n=1461)

Outcome	**Cool season**			**Warm season**			**Whole study period**		
	Mean (S.D.)	Min.	Max.	Mean (S.D.)	Min.	Max.	Mean (S.D.)	Min.	Max.
0-14 y	21.5 (7.7)	1	67	17.3 (5.7)	5	44	18.7 (6.7)	1	67
15-64 y	28.2 (10.1)	4	77	22.0 (7.2)	6	46	24.0 (8.8)	4	77
>64 y	4.5 (2.6)	0	14	3.6 (2.1)	0	10	3.9 (2.3)	0	14
TOTAL	54.2 (16.4)	7	134	43.0 (11.0)	14	84	46.7 (14.1)	7	134

Table 4 Year-end population by three age group for study area of Taipei, Taichung and Kaohsiung, 2000

District	0-14 y	15-64 y	>64 y	Total
Taipei	519,673	1,870,882	255,919	2,646,474
Taichung	230,296	672,816	62,678	965,790
Kaohsiung	299,793	1,084,070	106,697	1,490,560

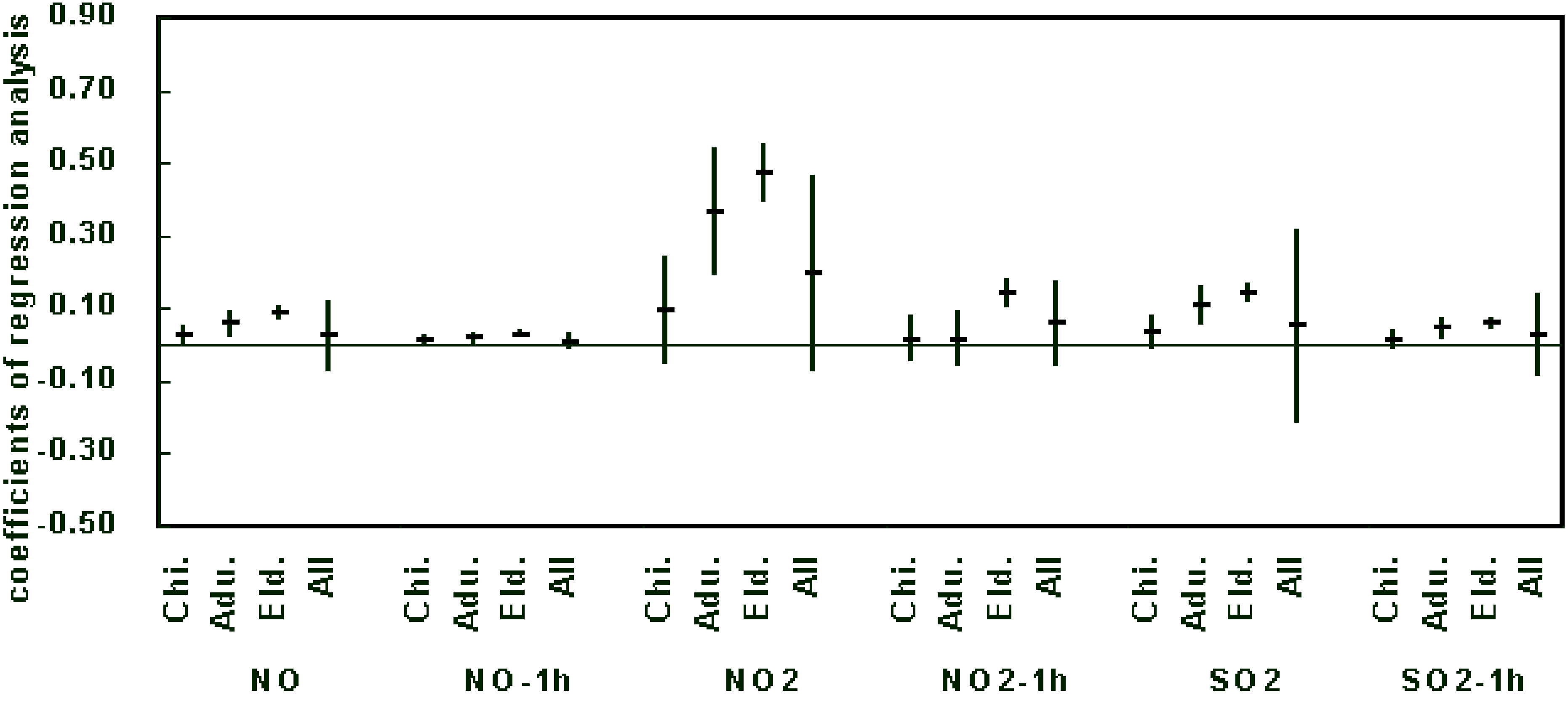

Fig. 6 Coefficients of regression and 95% confidence intervals (CIs) for respiratory admission per unit increase in NO, NO_2, SO_2 Taipei.

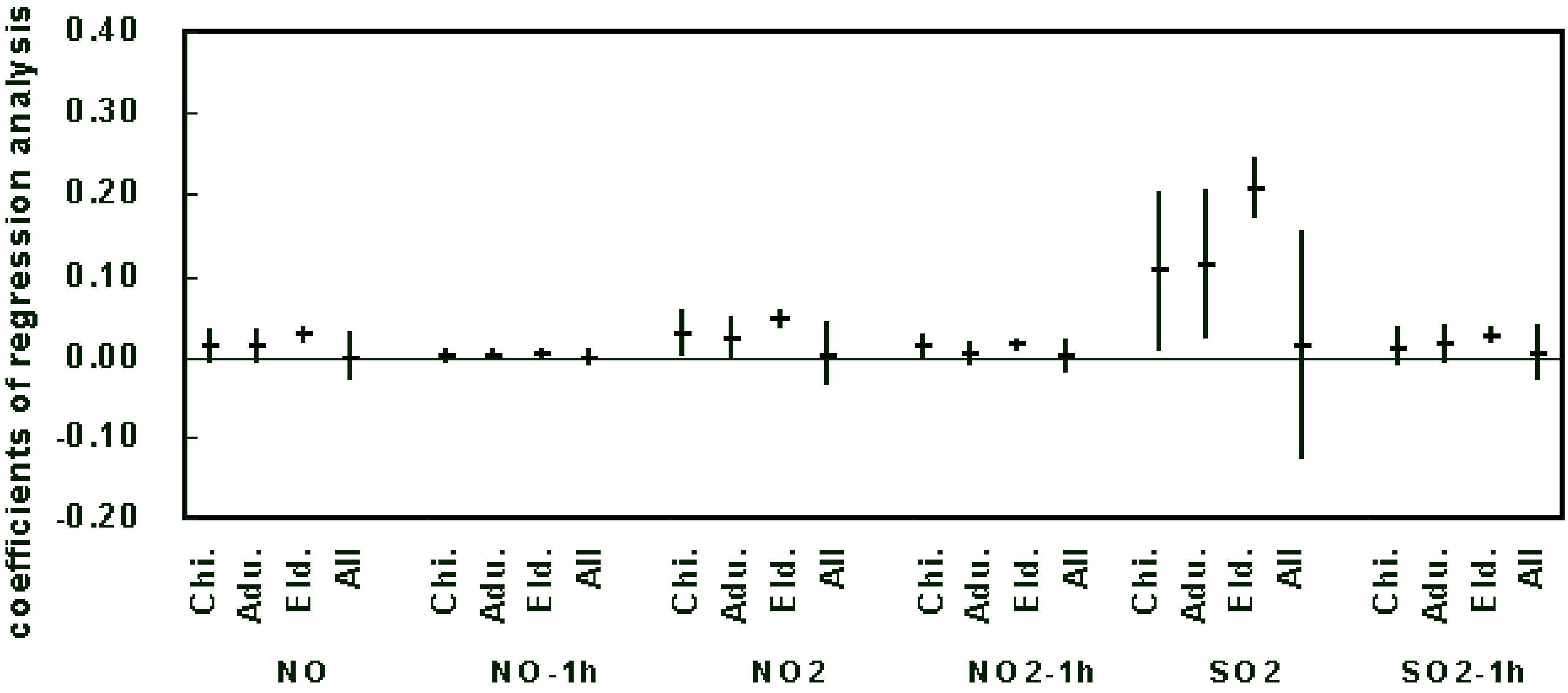

Fig. 7 Coefficients of regression and 95% confidence intervals (CIs) for respiratory admission per unit increase in NO, NO_2, SO_2, Taichung.

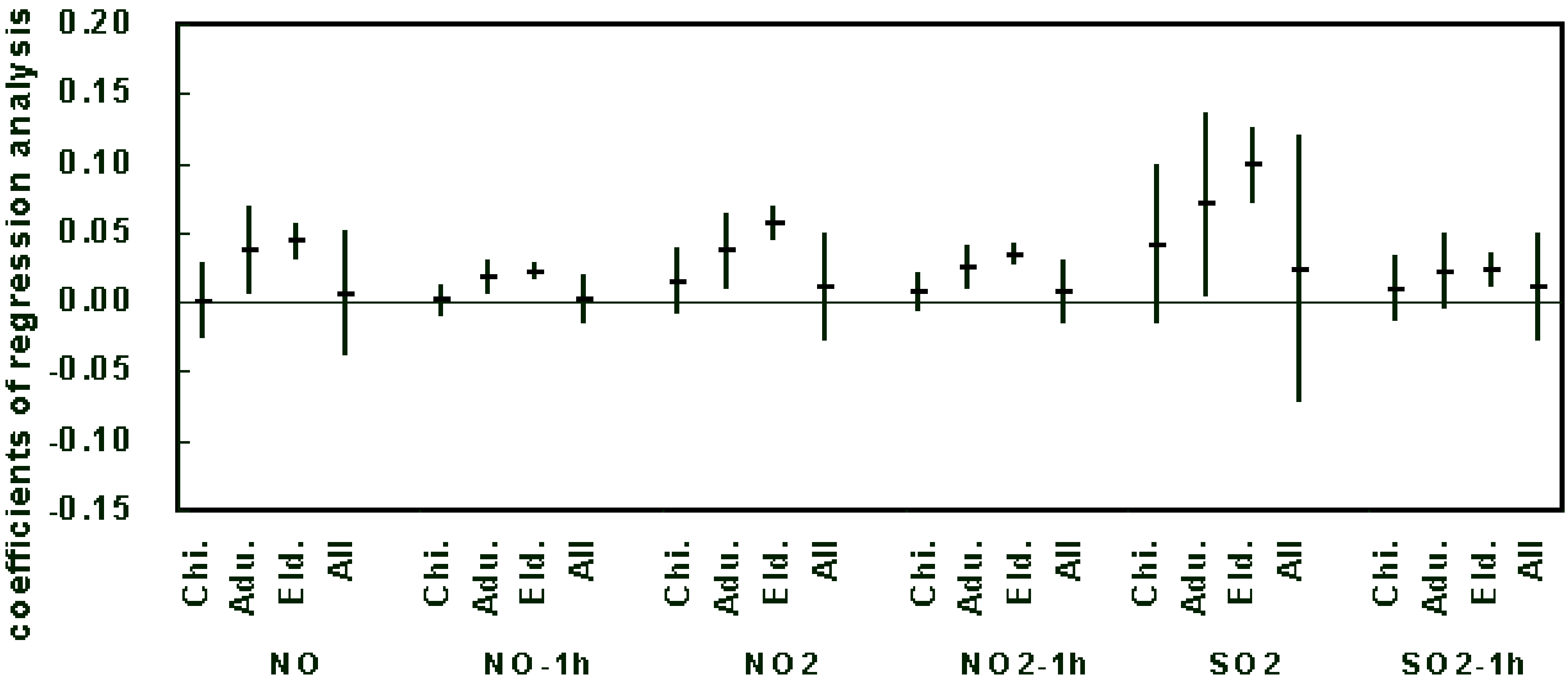

Fig. 8 Coefficients of regression and 95% confidence intervals (CIs) for respiratory admission per unit increase in NO, NO_2, SO_2, Kaohsiung.

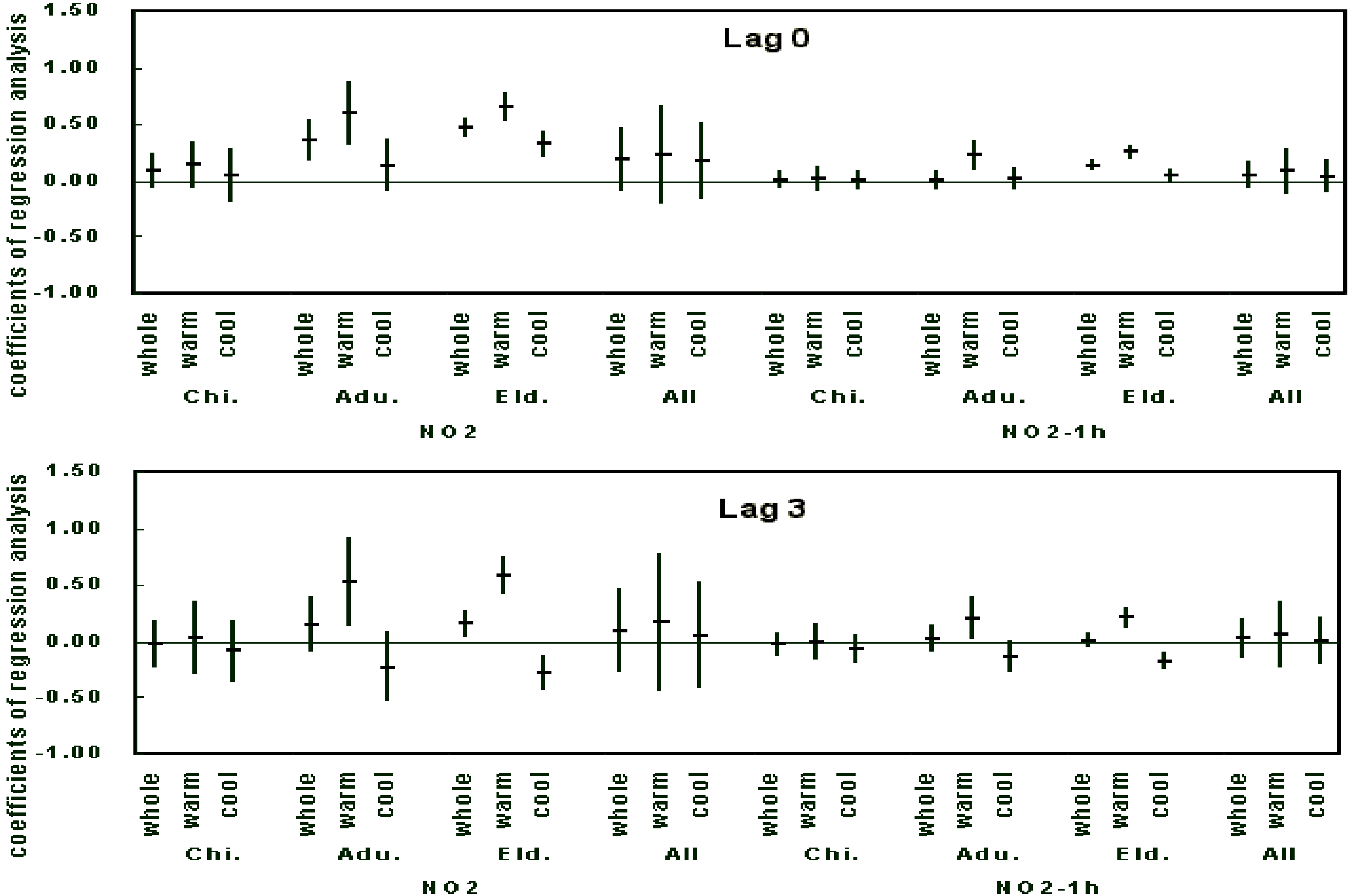

Fig. 9 Coefficients of regression and 95% confidence intervals (CIs) for respiratory admission per unit increase in NO_2, Taipei.

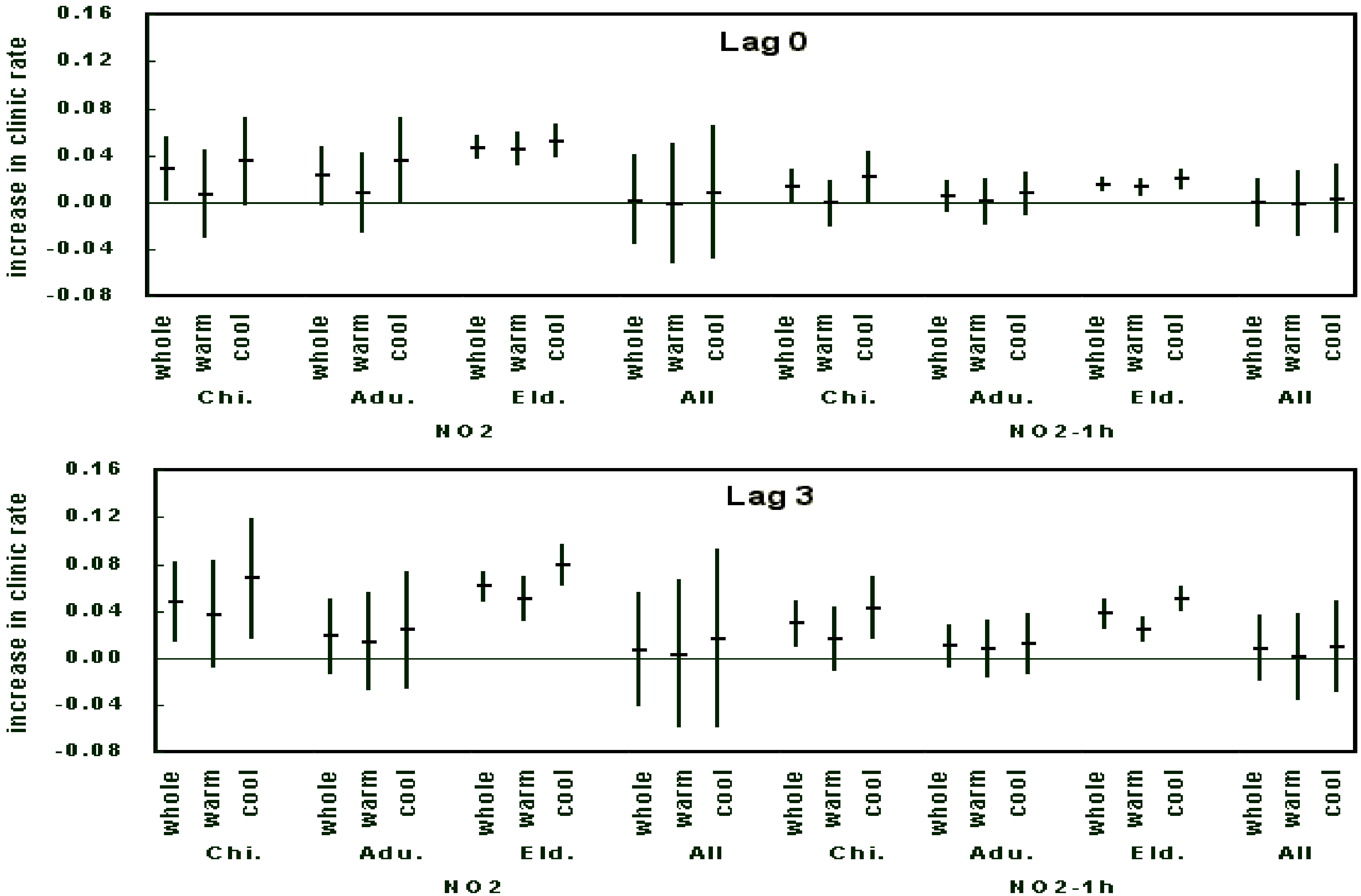

Fig. 10 Coefficients of regression and 95% confidence intervals (CIs) for respiratory admission per unit increase in NO_2, Taichung.

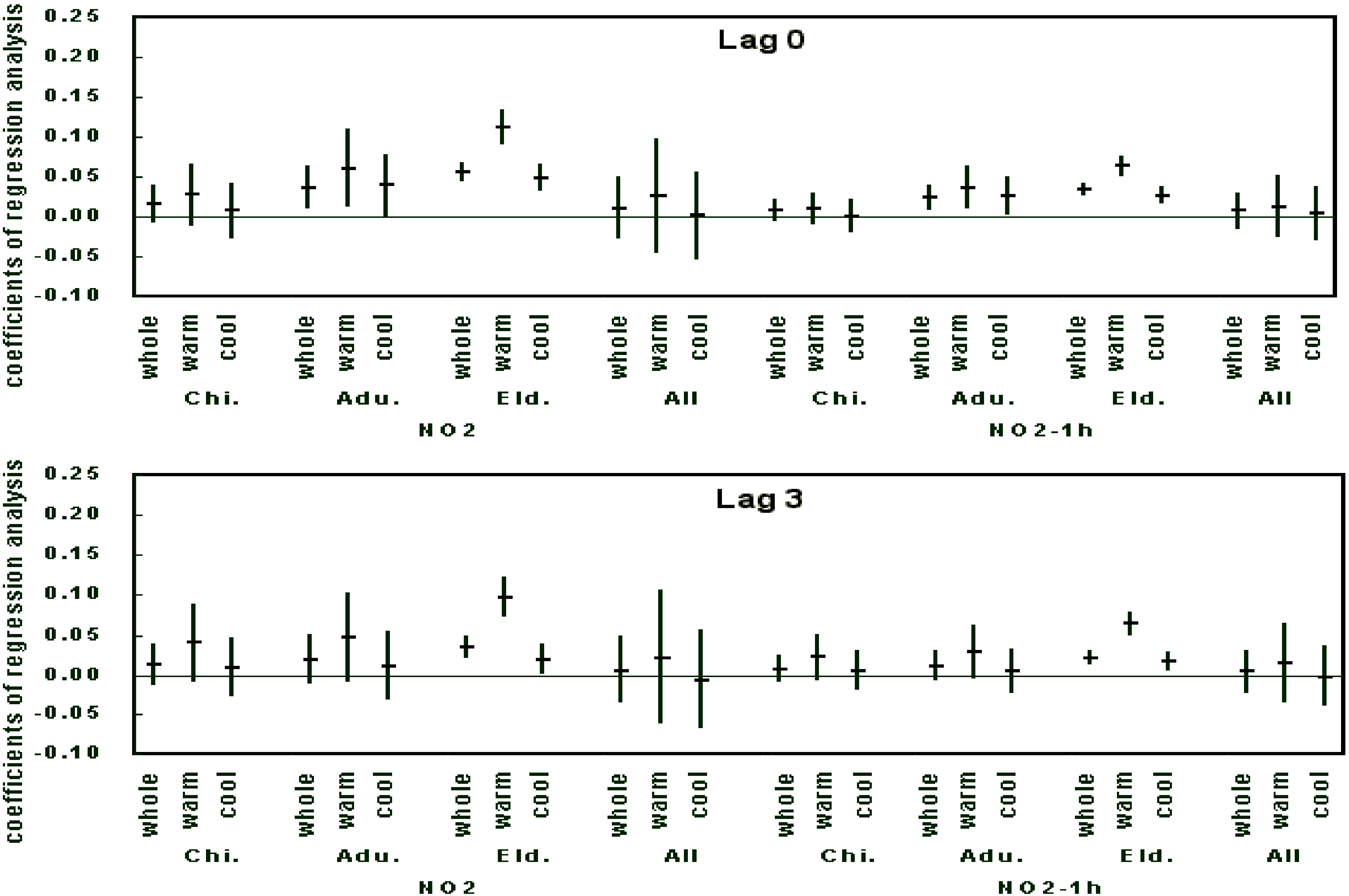

Fig. 11 Coefficients of regression and 95% confidence intervals (CIs) for respiratory admission per unit increase in NO_2, Kaohsiung.

Main findings

- The pollution effects were always the greatest for current-day exposures and decreased significantly as exposure time lags increased in Taipei city and Kaohsiung city.
- The elderly being the most susceptible.

- NO_2 had the greatest estimated coefficients increases in daily clinic visit for respiratory disease in Taipei city and SO_2 had the greatest estimated coefficients increases in daily clinic visit for respiratory disease in Taichung and Kaohsiung.

- Seasonal analysis indicate significant cool season relationships for air pollution in Taichung and significant warm season relationships in Taipei and Kaohsiung.

Discussion

- It is important to control for some confounding factor in the analysis, such as weather and temporal variables.
- A number of statistical approaches to controlling for such influences have been used in previous investigations into the health effects of air pollution.

- High collinearity among air pollutants prevents us from using multi-pollutant models, but we can modify the effects of air pollution by their character in the model .

- GAM process provides us with flexible model selection, diagnostics and simplified computation.
- However variables selection and calculations in the model are challenges.

- This methodology enabled results from many different European settings to be considered collectively. It represented the best available compromise between feasibility, comparability, and local adaptibility when using aggregated time series data not originally collected for the purpose of epidemiological studies.

Reference

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