

**Table 11. Case-Crossover Studies\***

Citation	Design	Study Location	Study Period	Study Sample	Exposure	Health Outcome	Summary of Published Findings
Chang CC, Tsai SS, Ho SC, et al. 2005. Air pollution and hospital admissions for cardiovascular disease in Taipei, Taiwan. <i>Environ Res</i> 98:114–119.	Case crossover	Taipei City, Taipei, China	1997–2001	Hospital admissions of 47 hospitals	PM <sub>10</sub> , NO <sub>2</sub> , CO, O <sub>3</sub>	Hospital admission for CVD	Significant associations were found between hospital admission for CVD and exposure to PM <sub>10</sub> , NO <sub>2</sub> , CO, and O <sub>3</sub> on warm days (>20°C). On cool days, PM <sub>10</sub> , NO <sub>2</sub> , and O <sub>3</sub> were significantly associated with admission for CVD.
Kan H, Chen B. 2003. A case-crossover analysis of air pollution and daily mortality in Shanghai. <i>J Occup Health</i> 45:119–124.	Case crossover	Shanghai, China	2000–2001	64,862 deaths	PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub>	Mortality (total, COPD, and CVD)	Conditional logistic regression identified increases in relative risk of death from COPD and CVD.
Kwon HJ, Cho SH, Nyberg F, et al. 2001. Effects of ambient air pollution on daily mortality in a cohort of patients with congestive heart failure. <i>Epidemiology</i> 12:413–419.	Time series, Case crossover	Seoul, South Korea	1994–1998	1807 patients with congestive heart failure and admission history	PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub> , CO, O <sub>3</sub>	Mortality (nonaccidental)	An increase in PM <sub>10</sub> was associated with an increase in mortality from congestive heart failure. CO, NO <sub>2</sub> , SO <sub>2</sub> , and O <sub>3</sub> were also associated with mortality from congestive heart failure.
Kwon HJ, Hong YC, Lee JT, et al. 2002. Effects of ambient air pollution on daily mortality in a cohort of patients with stroke in Seoul, Korea. <i>Epidemiology</i> 13:S170.	Case crossover	Seoul, South Korea	1994–2000	Patients with stroke	PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub> , CO, O <sub>3</sub>	Daily mortality for all causes	Daily mortality in stroke patients was associated with the increased air pollution.
Lee JT, Schwartz J. 1999. Reanalysis of the effects of air pollution on daily mortality in Seoul, Korea: A case-crossover design. <i>Environ Health Perspect</i> 107:633–636.	Case crossover	Seoul, South Korea	1991–1995	12 million people	TSP, SO <sub>2</sub> , O <sub>3</sub>	Mortality (nonaccidental)	Increases in atmospheric SO <sub>2</sub> level were associated with increases in daily mortality across different analysis methods.
Lee JT. 2003. Association between air pollution and asthma-related hospital admissions in children in Seoul, Korea: A case-crossover study [in Korean]. <i>Korean J Prev Med</i> . 36:47–53.	Case crossover	Seoul, South Korea	–	Asthmatic children (< 15 yr)	PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub> , CO, O <sub>3</sub>	Hospital admission for asthma	These findings also support the hypothesis that air pollution, at levels below the current ambient air quality standards of Korea, is harmful to asthmatic children.
Lee YJ, Lee JT, Ju YS, et al. 2001. Short-term effect of air pollution on respiratory disease in Seoul: a case-crossover study [in Korean]. <i>Korean J Prev Med</i> 34:253–261.	Case crossover	Seoul, South Korea	1995–1996	Residents	O <sub>3</sub>	Daily emergency room visits	A 30 ppb increase of O <sub>3</sub> level was associated with a 91% increase in emergency room visits for respiratory diseases.
Tsai SS, Goggins WB, Chiu HF, et al. 2003. Evidence for an association between air pollution and daily stroke admissions in Kaohsiung, Taiwan. <i>Stroke</i> 34:2612–2616.	Case crossover	Kaohsiung, Taipei, China	1997–2000	23,179 hospital admissions for stroke	PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub> , CO, O <sub>3</sub>	Daily hospital admissions for stroke	The ambient level of PM <sub>10</sub> , NO <sub>2</sub> , SO <sub>2</sub> , CO, and O <sub>3</sub> were significantly associated with hospital admissions for both primary intracerebral hemorrhage and ischemic stroke on warm days (>20°C). On cool days, only CO levels and ischemic stroke hospital admissions were significantly associated.

\* Last updated June 2005.



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Tsai SS, Huang GH, Goggins WB, et al. 2003. Relationship between air pollution and daily mortality in a tropical city: Kaohsiung, Taiwan. <i>J Toxicol Environ Health</i> 66:1341–1349.	Case crossover	Kaohsiung, Taipei, China	1994–2000	All nonaccidental deaths	PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub> , O <sub>3</sub> , CO	RespD and circulatory mortality	No significant effects were found between PM <sub>10</sub> and SO <sub>2</sub> levels and respiratory mortality.
Yang CY, Chang CC, Chuang HY, et al. 2004. Relationship between air pollution and daily mortality in a subtropical city: Taipei, Taiwan. <i>Environ Int</i> 30:519–523.	Case crossover	Taipei, Taipei, China	1994–1998	2.64 million residents	PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub> , CO, O <sub>3</sub>	Daily mortality for all causes, respiratory diseases, and circulatory diseases	Effects were observed for NO <sub>2</sub> and CO levels on death due to respiratory disease, while weaker associations were observed for PM <sub>10</sub> , SO <sub>2</sub> , and O <sub>3</sub> .
Yang CY, Chen YS, Yang CH, et al. 2004. Relationship between ambient air pollution and hospital admissions for cardiovascular diseases in causing, Taiwan. <i>J Toxicol Environ Health A</i> 67:483–493.	Case crossover	Kaohsiung, Taipei, China	1997–2000	1.46 million residents	PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub> , CO, O <sub>3</sub>	Hospital admissions for CVD	Significant associations were found between PM <sub>10</sub> , SO <sub>2</sub> , NO <sub>2</sub> , CO, O <sub>3</sub> , and hospital admissions for CVD on warm days (>20°C), and for all pollutants except for O <sub>3</sub> on cool days (<20°C).

\* Last updated June 2005.

