

Ambient Air Pollution and Hospital Admission: Evidence from South Korea

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OBJECTIVES

To estimate the health effects of air pollution:

- respiratory hospital admissions due to increases in PM_{10} and O_3 concentrations
- taking into account avoidance behavior
- differentiated effects on chronic vs. non-chronic respiratory patients

INTRODUCTION

- Several studies emphasizing the relationship between air pollution and health have been conducted in recent decades.
- An important part overlooked by many previous papers on the health effects of air pollution is that as air pollution increases, the number of hospital visits for treatment does not rise monotonically and linearly.
- This paper estimates the health effects of air pollution and examines the effects of avoidance behaviors on these estimates in South Korea.
- The Korean medical system provides a good environment for studying acute adverse health effects of air pollution on health: a) single health care network; b) easy accessibility to a hospital or healthcare facility; c) low healthcare costs.

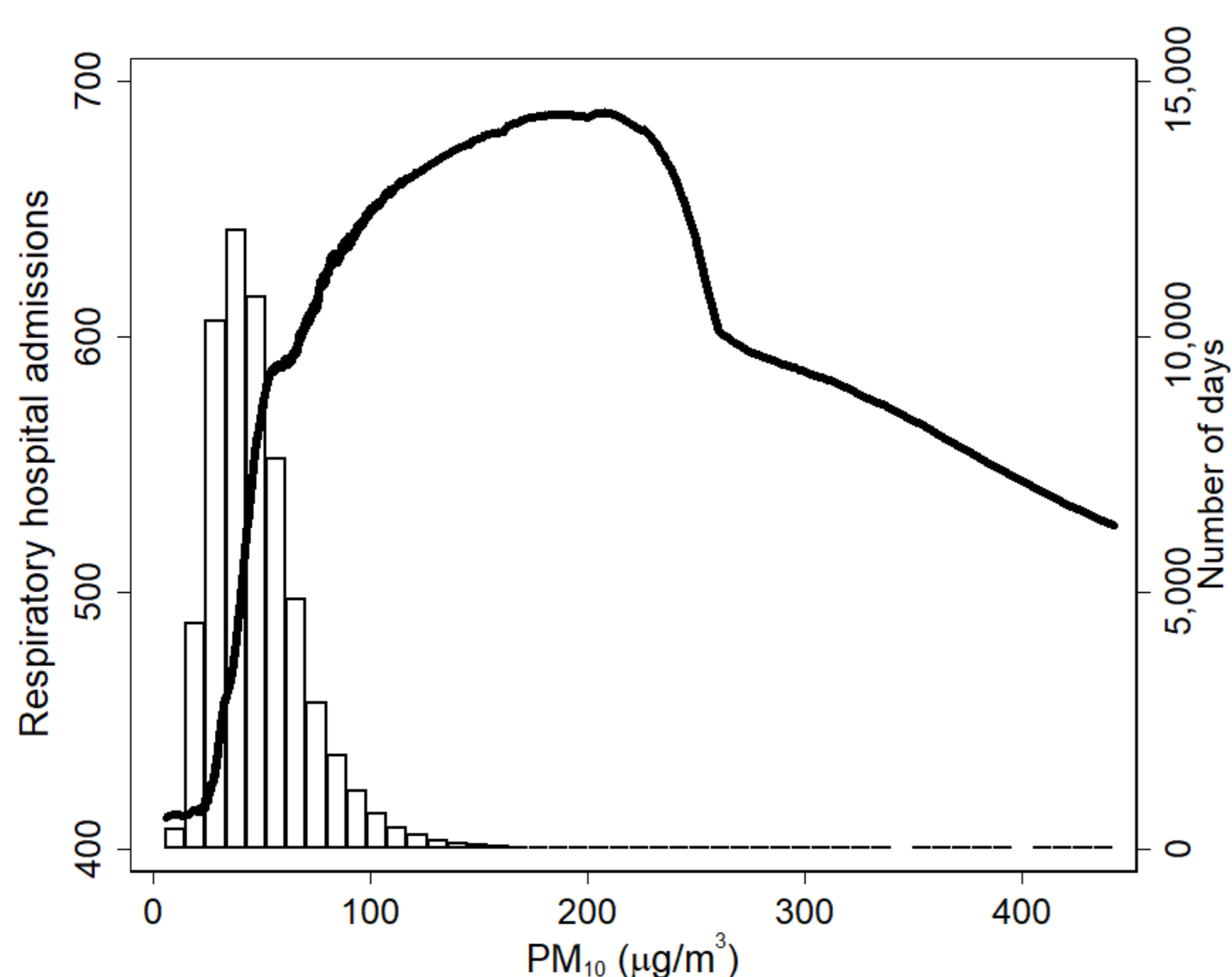
DATA

The data used in this study cover all cities and provinces in South Korea (7 metropolitan cities and 9 provinces) from January 1, 2006 to December 31, 2015, including:

- Hospitalization data: Korean National Health Insurance Service (NHIS)
- Air quality information: Korea Environment Corporation (KECO)
- Weather data: Korea National Climate Data Service System (NCDSS)

AVOIDANCE BEHAVIOR

- According to the “Clean Air Preservation Act,” the Korean Ministry of Environment (MOE) issues advisories or warnings in three situations: 1) Asian dust storms; 2) high levels of particulate matter (PM_{10} , $PM_{2.5}$); 3) high levels of ozone (O_3).
- When an alert is issued, people behaviorally respond by avoiding discretionary outdoor activities, including hospital care.
- Hence, estimates of the health effects of air pollution that do not take into account avoidance behavior are likely underestimated.



EMPIRICAL STRATEGY

Poisson regression is the starting point for count data analysis. Poisson distribution, however, relies on a key assumption that the conditional variance is equal to the conditional mean. In this study, I estimate a Poisson quasi-maximum likelihood estimator that relaxes the assumption:

$$E[y_{ct} | X_{ct}, M_{ct}, \delta_c] = \delta_c \exp(\beta_1 Poll_{ct} + \beta_2 Alert_{ct} + \beta_3 [Alert_{ct} \times Poll_{ct}] + \beta_4 X_t + \beta_5 M_t + \beta_6 f(t)) \quad (1)$$

where y_{ct} : daily respiratory hospital admissions; $Poll$: daily ambient air pollution concentration (PM_{10} or O_3); $Alert$: alert dummy (that equals 1 if the ambient air pollution level exceeds the daily standard level, 0 otherwise); X_{ct} : humidity and temperature, M_t : dummy variables for day of week, holiday, month, year; $f(t)$: time trends (t and t^2); δ_c : city/province fixed effects.

RESULTS

	PM_{10}		O_3	
	1	2	3	4
$Poll$	0.0007*** (0.0002)	0.0019*** (0.0005)	0.0218*** (0.0066)	0.0236*** (0.0066)
$Alert$		0.0867* (0.0499)		0.2697 (0.2754)
$Poll \times Alert$		-0.002*** (0.0007)		-0.0841 (0.0674)

Table 1: Contemporaneous health effects of air pollution and avoidance behavior

	PM_{10}		O_3	
	1 Chronic	2 Non-chronic	3 Chronic	4 Non-chronic
$Poll$	0.00049*** (0.00004)	0.00062*** (0.00003)	0.0039*** (0.0008)	0.0035*** (0.0005)
$Alert$	0.02019*** (0.00435)	0.02786*** (0.00309)	0.0241 (0.0232)	0.0324* (0.0171)
$Poll \times Alert$	-0.00048*** (0.00005)	-0.00053*** (0.00004)	-0.0130** (0.0051)	-0.0116*** (0.0037)

Table 2: Contemporaneous health effects of air pollution on chronic respiratory patients

CONCLUSION AND POLICY IMPLICATION

- A $10 \mu g/m^3$ increase in PM_{10} leads to a 1.9 percent increase in respiratory hospital admissions.
- This is 3 times larger than the estimate that does not take into account air quality information, suggesting that people respond to PM_{10} alerts and estimates omitting avoidance behavior are downward biased.
- A 0.01 ppm increase in O_3 leads to a 2.4 percent increase in respiratory hospital admissions. The estimate of the effect of ozone on hospital admissions that does not include ozone alerts is 2.2 percent, suggesting that omitting alerts for ozone may give rise to a smaller estimate.
- O_3 has larger impacts on patients with chronic respiratory diseases, while PM_{10} has greater impacts on non-chronic respiratory patients.
- The results suggest that those two types of air pollutants have differential significant impacts, and therefore separate policies may be needed to address both pollutants.
- Korean government’s guidance on air pollution only recommends that chronic respiratory patients be given more care, regardless of the type of air pollutant and, therefore, the guidelines and alert system for air pollution should be revised to take into account the different effects of both air pollutants.