

The effects of short-term exposure on hospital admissions for acute lower respiratory infections in young children of Ho Chi Minh City

Collaborative Working Group on Air Pollution, Poverty, and Health
in Ho Chi Minh City (HCMC)**

In cooperation with an initiative of the Asian Development Bank, an interdisciplinary team of local and international experts is conducting a unique program to assess the health effect of air pollution among the poor in Ho Chi Minh City (HCMC). The project has two complementary components – a hospital-based study and a household-based study (discussed here). In the hospital study, we estimate the effect of short-term exposure to air pollution on hospital admissions for acute lower respiratory infections in young children (<5 years) in HCMC, and compare the magnitude of the effect of air pollution on poor children vs. other children. The poor may experience higher actual exposures to air pollution than the non-poor, but this would not be reflected by the ambient monitors used to assess exposure in the hospital study. Therefore, there is a need to assess the extent to which localized sources may contribute to exposure measurement error arising from the use of ambient monitoring site data for estimating the health impacts, particularly for different sub-groups. The objective of the household study is to assess determinants of personal exposure for the poor and non-poor, and to explore whether the use of ambient monitors as a surrogate for personal exposures results in differential exposure misclassification by socio-economic status (SES).

Specific Aims

1. To assess the effects of exposure to air pollution on hospitalization for ALRI of children under five years of age in HCMC from 2003 - 2005 using time series and case crossover analyses. The study focused on the effects of daily average exposure to PM10 and Ozone.
2. To compare the magnitude of the effect of air pollution on poor children versus other children in the case crossover analysis using individual and group-level indicators of poverty status

Case Ascertainment

Admissions for pneumonia, bronchiolitis, and bronchitis in children less than five years of age were extracted from computerized records of the two Children's Hospitals (CH1 and CH2) of Ho Chi Minh City (HCMC). Nearly all children admitted for respiratory illnesses in HCMC are hospitalized in one of these two pediatric hospitals. Thus, we captured nearly all children's admissions for acute respiratory illness in HCMC.

ALRI admissions by age, sex, and outcome category, 2003-2005

	Children Hospital 1 N=(7462)	Children Hospital 2 (N=20263)	Combined N=(28085)
Male	71.1%, (5305)	60.9%, (12550)	63.6%, (17855)
Female	28.9%, (2157)	39.1%, (8073)	36.4%, (10230)
0	36.6%, (2729)	23.6%, (4877)	27.1%, (7606)
1	37.6%, (2809)	40.0%, (8241)	39.3%, (11050)
2	17.1%, (1277)	22.6%, (4657)	21.1%, (5934)
3	5.8%, (432)	8.5%, (1747)	7.8%, (2179)
4	2.3%, (175)	3.7%, (753)	3.3%, (928)
5	0.5%, (40)	1.7%, (348)	1.4%, (388)
Pneumonia	33.5%, (2501)	34.1%, (7023)	33.9%, (9524)
Bronchiolitis	43.1%, (3217)	16.8%, (3457)	23.8%, (6674)
Other ALRI	23.4%, (1744)	49.2%, (10143)	42.3%, (11887)

* Includes collaborators from the HCMC Department of Public Health, Environmental Protection Agency (HEPA), and the Pediatric Hospitals, as well as the Health Effects Institute, Beth Israel Deaconess Medical Center, and the University of Hong Kong.

Air Quality Data

Daily, city-level exposure estimates of particulate matter with diameter less than 10 microns (PM10), Ozone, NO₂, and SO₂ were generated using data from the HCMC Environmental Protection Agency's (HEPA) ambient air quality monitoring network. Daily meteorological information including temperature and relative humidity were collected from KTTV NB, the Southern regional hydro-meteorological center.

Effect Modification by Socio-Economic Position (SEP)

- Individual indicators of SEP were based on degree of payment exemption from the hospital financial records.
- District-level estimates of poverty prevalence in 2004 were obtained from a poverty mapping collaboration project of the Institute of Economic Research and the World Bank. Poverty prevalence was defined as the 6 million VND income poverty line of set by the People's Committee of HCMC. Quartiles of district-level poverty incidence were created based on the poverty prevalence estimates for each district.

Analytic Approaches

Time-series analysis: The unit of observation is daily counts of hospital admissions for acute lower respiratory infection. We used Poisson regression with smoothing functions for meteorological variables, and variables for seasonal and long-term trends. Distributed lag functions were used to examine the effect of pollutant and temperature lags.

Case-crossover analysis: The case period (the duration of time which a child with ALRI gets admitted to the hospital) was defined to be 7 days before the admission date. The time-stratified control periods were defined using methods that compare pollution levels on days before and after the admission period.

Results

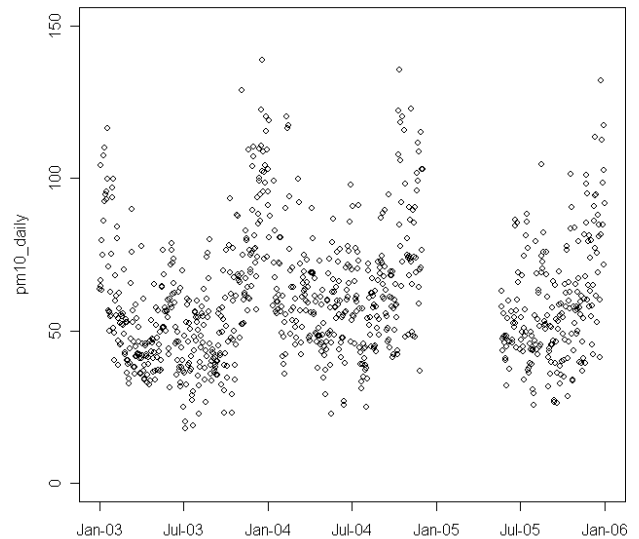
Large seasonal differences in admission patterns and pollution levels were observed. Around 60% of ALRI admissions occur during the rainy season, while the highest pollutant concentrations are observed in the dry season. Results differed markedly when analyses were stratified by (rather than simply adjusted for) season.

Because there is variability (on the order of days) in the time between onset of illness and hospital admission, it was not possible to definitively identify an appropriate single day lag. We focus on the results for lag 0 and average lag 0-5, which takes pollution levels in the five days leading up to admission into account. Results were robust to differences in temperature lags, so only results for ave lag 0-5 of temperature are presented.

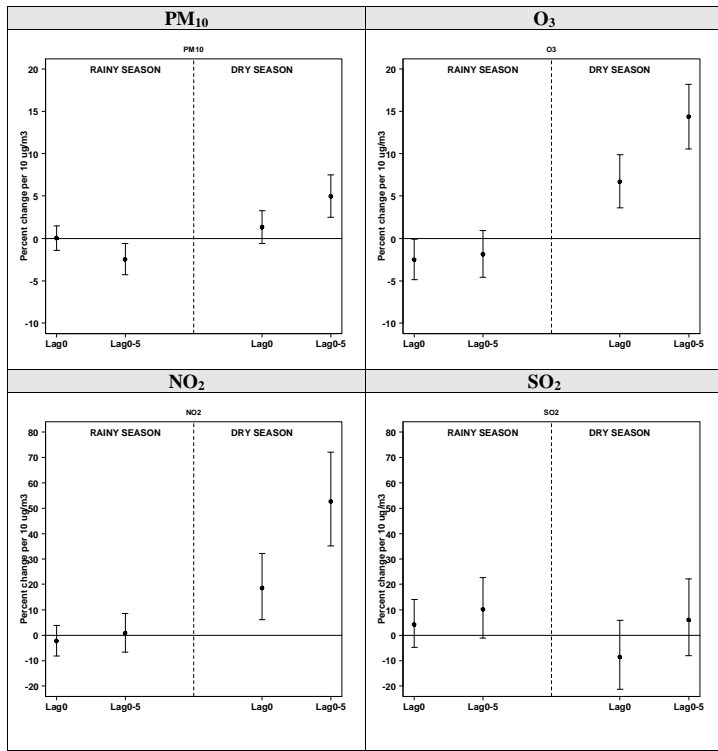
In general, positive associations between increased ALRI admissions and pollutants (PM10, Ozone, NO₂ and SO₂ and Ozone) were observed in the dry season, and negative associations were observed in the rainy season. With the exception of Ozone, results were generally consistent across time series and case crossover analyses. Ozone, NO₂ and SO₂ effects were consistently higher than PM effects, in both single pollutant and bipollutant models. Percent increases for the <1 age group tended to be larger, likely due to the fact that this is the population most susceptible to pneumonia and bronchiolitis.

Preliminary results do not suggest that short term exposures to air pollution impact children from different SEP differently, regardless of whether SEP is measured at the individual or district level. We are continuing to explore these relationships.

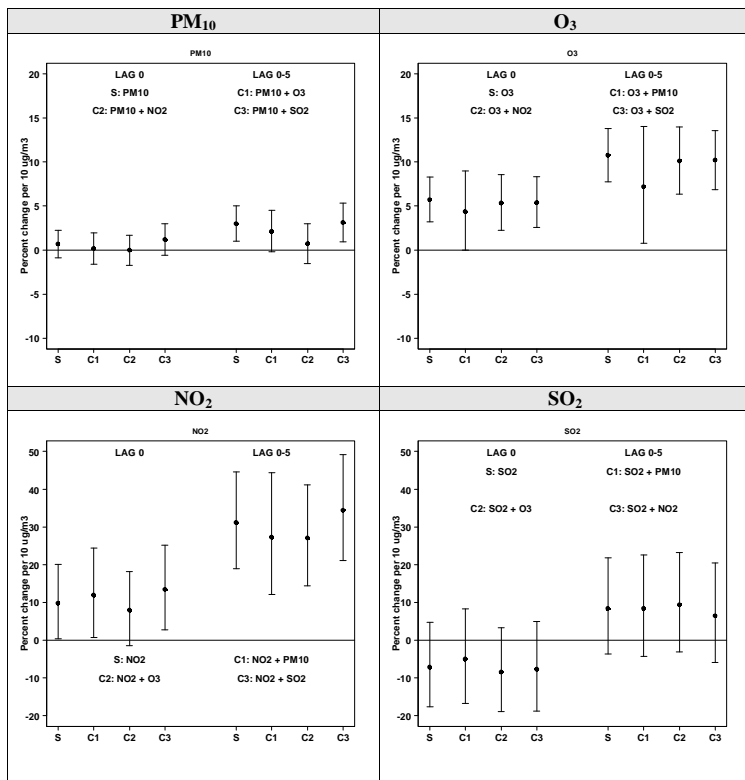
Average daily PM10 concentrations, 2003 – 2005



% increase in pneumonia and bronchiolitis hospitalizations, Poisson analyses, by season, ages 0-5 years



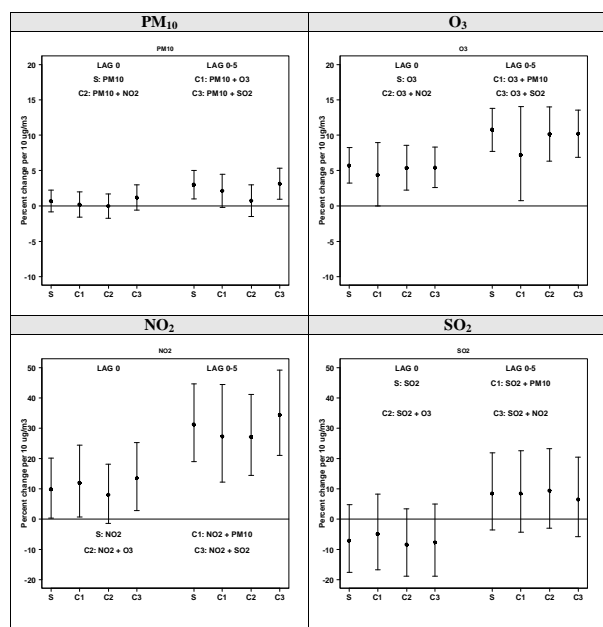
% increase in pneumonia and bronchiolitis hospitalizations, dry season, ages 0-5 years – Poisson vs. case-crossover analyses



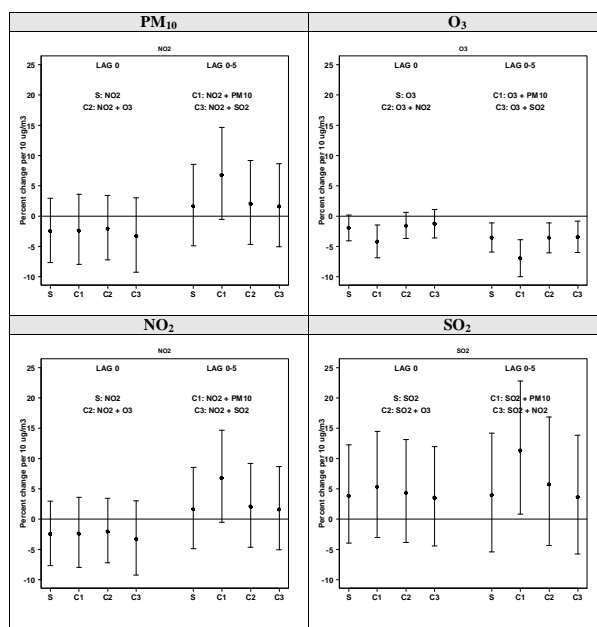
Co-pollutant models:

% increase in pneumonia and bronchiolitis hospitalizations, Poisson analyses, by season, ages 0-5 years

Dry Season



Rainy Season



Discussion

Preliminary results suggest that increased concentrations of air pollutants, PM10, Ozone, NO2 and SO2, are associated with increased hospital admissions for ALRI in young children of HCMC, particularly in the dry season. While these analyses did not suggest differential effects by socio-economic position, there are several reasons why the limitations in data available for this analysis may be limit the ability to find such relationships:

- It is highly possible that poorer children systematically experience higher exposures to air pollution per unit of reported air quality on any given day compared to non-poor children. Since in these analyses a single daily measurement of pollution is assigned to all children for a particular day, however, it would not be possible to estimate daily differences in exposure across socio-economic status in this component. The second component of the study, which is underway currently and involves detailed monitoring of personal exposures, is designed to better evaluate these different exposures.
- Differential effects at a given level of exposure could reflect differential susceptibility among poor children mediated via mechanisms involving nutritional deficiencies, differential access to or quality of medical care, or other bio-social factors. Vietnam is a relatively egalitarian society which has tried to address class-related disparities on many levels. To the extent that they have been successful, they may have mitigated the inequities that confer increased susceptibility to air pollution.

Overall, this study makes an important contribution to the growing literature on the health effects of air pollution in Asia. This is, to the best of our knowledge, the first ever study of the health effects of air pollution in Ho Chi Minh City. In addition, it focuses on a much-understudied children's health outcome, acute lower respiratory illness, that is an illness responsible for a substantial burden of disease among young children in developing countries. Further analyses in the household study will examine potential relationships with poverty and exposure at a much greater level of detail.

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