Supplemental Material

Air pollution control and the occurrence of acute respiratory illness in school children of Quito, Ecuador.

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1. Weather description

While the general climate of Ecuador is hot and subtropical, the climate of Quito, the national capital, is defined by its mountainous location. The city is situated 2850m above the sea level in the Andean Region. While the monthly temperatures are stable throughout the year averaging ~15°C, the season are defined by precipitation. The dry (summer) season generally extends from June to September with the rest of the months reserved for rainy (winter) season (Table S1).

Table S1. Monthly average meteorological characteristics for 2000 and 2007.

	2000		2007	
Month	Monthly Precip sum	Monthly Average Shade air temperature (ºC)	Monthly Precip sum	Monthly Average Shade air temperature (ºC)
Jan	177.3	13.6	62.2	16.0
Feb	165.8	13.4	67.5	15.4
Mar	149.5	13.9	177.2	15.0
Apr	187.6	14.1	188.1	14.8
May	123.8	14.1	101.0	15.3
Jun	66.4	14.6	22.2	15.3
July	22.1	14.6	12.5	15.6
Aug	9.7	15.3	33.4	15.2
Sep	67.3	14.2	3.0	16.1
Oct	43.6	15.5	160.1	14.5
Nov	16.7	14.6	197.4	14.9
Dec	0.0	13.8	0.0	14.0

Data from: National Institute of Meteorology and Hydrology (INAMHI). Anuario Climatológico 2007. Quito, Ecuador. Available at www.serviciometeorologico.gob.ec/wp-content/uploads/anuarios/.../Am%202007.pdf

2. Model building for the relationship between ambient CO and COHb levels

The relationship between COHb levels and air quality on the day of and the day prior the blood draw was assessed by linear regression model. We included in the model individual characteristics (age, sex, underweight, stunting) and variables for the household sources of indoor air pollution (indoor firewood use and smoking). We developed the model in a sequential manner, starting with the simple analysis of relationship between log(COHb) and CO (Table S2). We then gradually increased the model complexity by adding the individual covariates (Table S3), and two meteorological characteristics (Table S4). Table S4 is limited to the ambient measurements for the day prior to COHb measurements. Please note, that in absence of actual measurements for air quality in 2000 we use interpolated values of 4.5mg/m^3 for daily CO level (Tables S2-S4).

Table S2. Regression models for log(COHb) measurement and CO ambient concentration for 2000 and 2007

	Beta	SE	*p*-value
the day of COHb measurements			
Constant	0.506	0.017	<0.0001
CO (mg/m^3)	0.145	0.007	<0.0001
the day prior to COHb measurements			
Constant	0.511	0.017	<0.0001
CO (mg/m^3)	0.144	0.007	<0.0001

Table S3. Adjusted regression models for log(COHb) measurement and CO ambient concentration for 2000 and 2007

	2000 and 2007		
	Beta	SE	*p*-value
the day of COHb measurements			
Constant	0.787	0.076	<0.0001
CO (mg/m^3)	0.127	0.008	<0.0001
Age (year)	-0.024	0.008	0.002
Female	-0.037	0.021	0.082
Underweight[1]	-0.009	0.036	0.800
Stunted[2]	-0.025	0.026	0.346
Indoor fire wood use	0.016	0.157	0.920
Indoor smokers	-0.058	0.026	0.027
R^2 = 0.288			
the day prior to COHb measurements			
Constant	0.787	0.076	<0.0001
CO (mg/m^3)	0.127	0.008	<0.0001
Age (year)	-0.023	0.008	0.002
Female	-0.039	0.021	0.067
Underweight[1]	-0.004	0.036	0.919
Stunted[2]	-0.031	0.026	0.232
Indoor fire wood use	0.007	0.156	0.964

Indoor smokers	-0.063	0.008	<0.0001

$R^2 = 0.292$

[1] Underweight was defined as weight for age Z score < -2SD

[2] Stunted was defined as height for age Z score < -2SD

Table S4. Adjusted regression adjusted Model for log(COHb) measurement and CO ambient concentration for 2000 and 2007

	2000 and 2007		
	Beta	SE	*p*-value
the day prior to COHb measurements			
Constant	-5.590	1.224	<0.0001
CO (mg/m^3)	0.049	0.026	0.058
Age (year)	-0.021	0.007	0.005
Female	-0.021	0.021	0.317
Underweight[1]	0.009	0.035	0.788
Stunted[2]	-0.028	0.025	0.276
Indoor fire wood use	0.002	0.150	0.988
Indoor smokers	-0.057	0.002	0.023
Ambient Temperature (ºC)	0.358	0.710	<0.0001
Precipitation (mm)	0.011	0.002	<0.0001

$R^2 = 0.345$

[1] Underweight was defined as weight for age Z score < -2SD

[2] Stunted was defined as height for age Z score < -2SD

We then run a regression model for only 2007, which included actual measurements for available air pollutant (except for NO and O3 due to incomplete records) as well as for temperature and precipitation for the day prior to COHb measurements (Table S5). In contrast to model presented in Table S4, where the effect of CO is driven by the substantial decline of CO concentration, the relationship between COHb measurements and ambient CO levels were not significant.

Table S5. Adjusted regression model for log(COHb) measurement and ambient concentration for CO, SO_2 and $PM_{2.5}$ measured on a day prior the COHb measurements for the 2007 study.

	2007		
	Beta	SE	p value
Constant	1.670	0.734	0.002
CO (mg/m^3)	-0.016	0.021	0.451
SO_2 (μ/m^3)	-0.003	0.004	0.396
$PM_{2.5}$ (μ/m^3)	0.002	0.002	0.173

Age (year)	0.003	0.005	0.577
Female	0.018	0.014	0.190
Underweight[1]	-0.003	0.022	0.904
Stunted[2]	-0.013	0.016	0.404
Indoor fire wood use	0.158	0.126	0.212
Indoor smokers	-0.012	0.017	0.472
Ambient Temperature (ºC)	-0.037	0.046	0.425

$R^2 = 0.012$

[1] Underweight was defined as weight for age Z score < -2SD

[2] Stunted was defined as height for age Z score < -2SD

3. **Model building for the relationship between ambient CO and COHb levels and respiratory illness**

We constructed a Poisson regression model for ARI occurrence for 2000 and 2007 with COHb level and CO concentration values (same day) and adjusted for individual covariates. Only COHb levels are significant associated with number of episodes of ARI (Table S6).

Table S6. Adjusted Poisson regression model for ARI (number of episodes) and COHb concentration for 2000 and 2007

	2000 and 2007		
	Exp (Beta)	95 CI	p value
the day of COHb measurements			
Constant	0.645	0.344-1.208	0.170
COHb (%)	1.215	1.125-1.314	< 0.0001
CO (mg/m^3)	0.992	0.923-1.065	0.821
Age/year	0.947	0.892-1.005	0.073
Female	1.060	0.900-1.249	0.488
Underweight[1]	1.060	0.813-1.382	0.669
Stunted[2]	1.188	0.976-1.447	0.086
Indoor fire wood use	1.648	0.678-4.003	0.270
Indoor smokers	1.102	0.908-1.337	0.326

[1] Underweight was defined as weight for age Z score < -2SD

[2] Stunted was defined as height for age Z score < -2SD

4. **Model building for the relationship between ambient CO, SO_2 and $PM_{2.5}$ levels and respiratory illness in 2007.**

We constructed a Poisson regression model for ARI occurrence for 2007 with CO, SO_2 and $PM_{2.5}$ concentration values (same day of COHb measurements) and adjusted for individual covariates. CO, SO_2 levels were significantly associated with the number of episodes of ARI (Table S7).

Table S7. Adjusted Poisson regression model for ARI (number of episodes) and air pollutants in 2007

	2007 RR (95% CI)	*P*-value
CO (mg/m^3)[1]	1.56 (1.17–2.08)	0.002
SO_2 (μg/m^3)[1]	1.10 (1.04–1.16)	>0.0001
$PM_{2.5}$ (μg/m^3)[1]	0.98 (0.95–1.01)	0.060
Age/year	0.91(0.85–0.09)	0.007
Female	1.06 (0.89–1.27)	0.469
Underweight[2]	1.20 (0.98–1.47)	0.472
Stunted[3]	1.17 (0.96–1.44)	0.066
Indoor fire wood use	0.62 (0.14–2.76)	0.539
Indoor smokers	1.14 (0.93–1.39)	0.186

Rate Ratio (RR) - results from the Log-linear Poisson Generalized Estimating Equation model

[1] Continuous variable on the day of COHb measurement

[2] Underweight was defined as weight for age Z score <-2SD

[3] Stunted was defined as height for age Z score < -2SD