

Supplemental Material

**Fine Particulate Matter Components and Emergency Department
Visits for Cardiovascular and Respiratory Diseases in the St. Louis,
Missouri–Illinois, Metropolitan Area**

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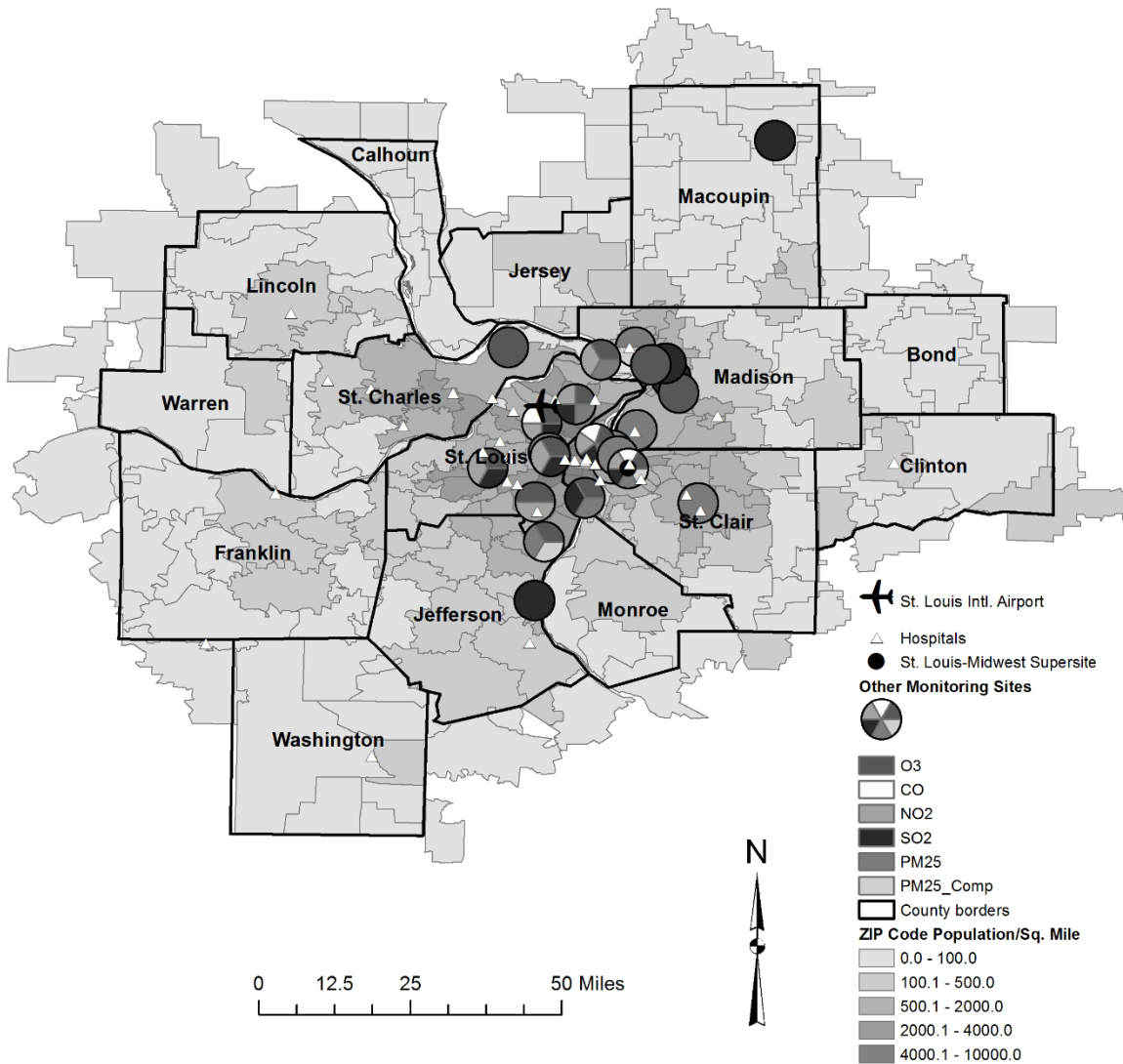


Figure S1. Map of St. Louis study area, with locations of hospitals and air quality monitoring sites.

Table S1. Emergency department visit summary statistics for St. Louis, 6/1/2001-4/30/2003.^a

Outcome [ICD-9 Codes]	Total number of visits	Mean daily visits \pm SD
All Diseases	1,733,543	2,480.0 \pm 160.9
Cardiovascular disease^b	69,679	99.7 \pm 12.8
Ischemic heart disease [410-414]	22,097	31.6 \pm 6.7
Dysrhythmia [427]	13,822	19.8 \pm 4.8
Congestive heart failure [428]	17,148	24.5 \pm 5.7
Respiratory disease^c	186,449	266.7 \pm 72.0
Pneumonia [480-486]	32,166	46.0 \pm 14.5
Chronic obstructive pulmonary disease [491, 492, 496]	10,377	14.8 \pm 4.6
Asthma or wheeze [493, 786.07]	34,086	48.8 \pm 14.6

^aAnalyses exclude data from 7/4/2001, 7/4/2002, and 7/5/2002. ^bCardiovascular disease outcome included visits for ischemic heart disease [410-414], cardiac dysrhythmia [427], congestive heart failure [428], and other CVD [433-437, 440, 443-445, 451-453; i.e., peripheral and cerebrovascular diseases]. ^cRespiratory disease outcome included visits for pneumonia [480-486], chronic obstructive pulmonary disease [491, 492, 496], asthma/wheeze [493, 786.07], and other RD [460-466, 477; i.e., upper respiratory infection and bronchiolitis].

Table S2. Pearson correlation coefficients among all pollutants measured at the St. Louis-Midwest Supersite/Tudor Ave. AQS monitoring location, 6/1/2001-4/30/2003.^a

Pollutant	PM _{2.5}	SO ₄ ²⁻	NO ₃ ⁻	OC	EC	Oct	Non	Nor	Hop	Chry	BbkF	BaP	IcdP	Si	K	Ca	Fe	Cu	Zn	Pb	O ₃	CO	NO ₂	SO ₂
Fine Particles																								
24-hr avg PM _{2.5}	1.00																							
Major Ions																								
24-hr avg SO ₄ ²⁻	0.78	1.00																						
24-hr avg NO ₃ ⁻	0.29	0.01	1.00																					
Carbon																								
24-hr avg OC	0.76	0.45	0.05	1.00																				
24-hr avg EC	0.33	0.00	0.12	0.60	1.00																			
n-Alkanes																								
24-hr avg Oct	0.32	0.05	0.11	0.50	0.51	1.00																		
24-hr avg Non	0.31	0.13	-0.06	0.51	0.40	0.68	1.00																	
Hopanes																								
24-hr avg Nor	0.25	-0.03	0.13	0.46	0.56	0.52	0.23	1.00																
24-hr avg Hop	0.30	0.01	0.17	0.55	0.58	0.53	0.35	0.86	1.00															
PAHs																								
24-hr avg Chry	0.05	-0.34	0.46	0.14	0.43	0.32	0.06	0.49	0.43	1.00														
24-hr avg BbkF	0.18	-0.20	0.39	0.28	0.54	0.43	0.17	0.55	0.47	0.89	1.00													
24-hr avg BaP	0.12	-0.24	0.26	0.30	0.60	0.45	0.27	0.51	0.46	0.77	0.86	1.00												
24-hr avg IcdP	0.20	-0.11	0.26	0.32	0.49	0.42	0.16	0.53	0.41	0.72	0.79	0.70	1.00											
Metals and Metalloids																								
24-hr avg Si	0.33	0.28	-0.30	0.45	0.26	0.23	0.38	0.17	0.24	-0.07	-0.03	0.02	0.04	1.00										
24-hr avg K	0.59	0.33	0.02	0.65	0.36	0.35	0.39	0.32	0.36	0.17	0.24	0.22	0.29	0.63	1.00									
24-hr avg Ca	0.35	0.12	-0.15	0.56	0.50	0.37	0.37	0.40	0.45	0.21	0.24	0.30	0.25	0.73	0.58	1.00								
24-hr avg Fe	0.46	0.27	-0.03	0.52	0.55	0.40	0.38	0.35	0.38	0.29	0.42	0.43	0.40	0.55	0.47	0.61	1.00							
24-hr avg Cu	0.16	0.08	-0.07	0.26	0.20	0.13	0.13	0.25	0.28	0.05	0.07	0.10	0.10	0.22	0.25	0.28	0.25	1.00						
24-hr avg Zn	0.34	0.11	0.14	0.35	0.36	0.20	0.16	0.30	0.27	0.29	0.34	0.32	0.37	0.23	0.37	0.40	0.48	0.47	1.00					
24-hr avg Pb	0.35	0.12	0.03	0.48	0.47	0.34	0.26	0.44	0.39	0.32	0.41	0.39	0.45	0.26	0.43	0.42	0.47	0.53	0.68	1.00				
Criteria Gases																								
8-hr max O ₃	0.23	0.49	-0.57	0.30	-0.09	0.04	0.16	-0.07	-0.05	-0.42	-0.31	-0.27	-0.19	0.50	0.24	0.33	0.24	0.06	0.01	0.12	1.00			
1-hr max CO	0.25	-0.03	0.12	0.44	0.55	0.48	0.24	0.62	0.56	0.47	0.58	0.57	0.56	0.15	0.25	0.38	0.52	0.19	0.36	0.44	-0.01	1.00		
1-hr max NO ₂	0.35	0.23	-0.06	0.51	0.44	0.36	0.21	0.52	0.48	0.24	0.30	0.30	0.33	0.36	0.37	0.50	0.44	0.18	0.27	0.38	0.37	0.54	1.00	
1-hr max SO ₂	0.08	-0.05	0.05	0.10	0.07	0.02	-0.01	0.19	0.14	0.14	0.09	0.09	0.13	0.09	0.21	0.19	0.04	0.36	0.43	0.39	-0.04	0.12	0.15	1.00

^aMeasurements of PM_{2.5} and PM_{2.5} components made by St. Louis-Midwest Supersite instrumentation, and measurements of criteria gases (O₃, CO, NO₂, and SO₂) made by US Environmental Protection Agency Air Quality System Tudor Ave. instrumentation; all correlations exclude data from 7/4/2001, 7/4/2002, and 7/5/2002.

Table S3. Sensitivity analyses of associations between cardiovascular disease emergency department visits and ambient pollutants in St. Louis, 6/1/2001-4/30/2003.^a

Pollutant	IQR	Primary Model ^b	Lag -1 Pollution ^c	2 Knots per Month ^d	1 Knot Every 2 Months ^e	Indicator Lag 0 Maximum Temp ^f	5-day Distributed Lag ^g
Fine Particles and Components							
24-hr avg PM _{2.5}	11.1 µg/m ³	0.999 (0.981, 1.016)	1.012 (0.996, 1.028)	0.994 (0.975, 1.013)	1.003 (0.987, 1.020)	0.999 (0.982, 1.017)	1.014 (0.992, 1.037)
<i>Major Ions</i>							
24-hr avg SO ₄ ²⁻	3.2 µg/m ³	1.000 (0.986, 1.014)	1.008 (0.994, 1.022)	0.999 (0.984, 1.014)	1.003 (0.989, 1.017)	0.999 (0.985, 1.013)	1.016 (0.998, 1.033)*
24-hr avg NO ₃ ⁻	2.3 µg/m ³	1.002 (0.981, 1.024)	1.007 (0.992, 1.022)	0.999 (0.976, 1.022)	1.006 (0.986, 1.026)	1.005 (0.983, 1.027)	1.018 (0.991, 1.046)
<i>Carbon</i>							
24-hr avg OC	2.4 µg/m ³	1.015 (0.997, 1.033)*	1.012 (0.999, 1.024)*	1.015 (0.996, 1.034)	1.016 (0.999, 1.033)*	1.021 (1.002, 1.040)**	1.031 (1.008, 1.055)**
24-hr avg EC	0.42 µg/m ³	1.016 (1.002, 1.030)**	1.000 (0.989, 1.010)	1.014 (0.999, 1.030)*	1.017 (1.003, 1.030)**	1.016 (1.002, 1.031)**	1.010 (0.991, 1.030)
<i>n-Alkanes</i>							
24-hr avg Oct	0.77 ng/m ³	1.001 (0.994, 1.007)	1.007 (1.001, 1.013)**	1.002 (0.994, 1.009)	1.002 (0.996, 1.008)	1.002 (0.995, 1.008)	0.999 (0.990, 1.009)
24-hr avg Non	1.98 ng/m ³	0.998 (0.989, 1.007)	1.007 (1.000, 1.013)**	0.995 (0.984, 1.007)	0.999 (0.991, 1.007)	1.000 (0.991, 1.009)	0.999 (0.988, 1.010)
<i>Hopanes</i>							
24-hr avg Nor	0.43 ng/m ³	1.013 (0.998, 1.028)*	1.009 (0.999, 1.019)*	1.014 (0.999, 1.030)*	1.013 (0.999, 1.028)*	1.015 (1.000, 1.030)*	1.015 (0.995, 1.036)
24-hr avg Hop	0.24 ng/m ³	1.012 (1.000, 1.025)*	1.007 (0.998, 1.015)	1.013 (1.000, 1.027)*	1.012 (1.000, 1.024)*	1.015 (1.002, 1.028)**	1.012 (0.994, 1.030)
<i>PAHs</i>							
24-hr avg Chry	0.39 ng/m ³	1.005 (0.991, 1.020)	1.004 (0.994, 1.015)	1.006 (0.991, 1.022)	1.008 (0.994, 1.022)	1.007 (0.993, 1.022)	1.001 (0.981, 1.021)
24-hr avg BbkF	0.61 ng/m ³	1.007 (0.993, 1.020)	1.004 (0.994, 1.014)	1.007 (0.992, 1.021)	1.010 (0.997, 1.023)	1.009 (0.995, 1.023)	1.005 (0.986, 1.024)
24-hr avg BaP	0.19 ng/m ³	1.001 (0.994, 1.008)	1.003 (0.999, 1.008)	0.998 (0.990, 1.006)	1.002 (0.996, 1.008)	1.000 (0.994, 1.007)	0.999 (0.990, 1.008)
24-hr avg IcdP	0.27 ng/m ³	1.006 (0.995, 1.018)	1.003 (0.995, 1.010)	1.005 (0.992, 1.017)	1.008 (0.997, 1.018)	1.006 (0.995, 1.017)	1.006 (0.991, 1.021)
<i>Metals and Metalloids</i>							
24-hr avg Si	70.2 ng/m ³	0.995 (0.991, 0.999)**	1.002 (0.997, 1.007)	0.993 (0.988, 0.998)**	0.996 (0.992, 1.000)*	0.995 (0.991, 1.000)**	0.994 (0.985, 1.004)
24-hr avg K	35.5 ng/m ³	0.996 (0.987, 1.006)	1.005 (0.995, 1.015)	0.995 (0.985, 1.005)	0.999 (0.991, 1.008)	0.997 (0.988, 1.007)	0.989 (0.975, 1.003)
24-hr avg Ca	86.0 ng/m ³	0.994 (0.980, 1.009)	1.001 (0.992, 1.011)	0.993 (0.978, 1.009)	0.993 (0.980, 1.007)	0.994 (0.980, 1.009)	0.993 (0.975, 1.011)
24-hr avg Fe	85.9 ng/m ³	0.989 (0.978, 1.001)*	1.001 (0.992, 1.011)	0.986 (0.974, 0.999)**	0.992 (0.981, 1.002)	0.991 (0.979, 1.002)	0.992 (0.976, 1.008)
24-hr avg Cu	21.9 ng/m ³	1.001 (0.994, 1.008)	1.002 (0.998, 1.006)	0.999 (0.992, 1.007)	1.000 (0.993, 1.007)	1.000 (0.993, 1.007)	1.000 (0.990, 1.009)
24-hr avg Zn	37.9 ng/m ³	1.005 (0.998, 1.013)	1.003 (0.998, 1.007)	1.002 (0.994, 1.010)	1.005 (0.998, 1.012)	1.005 (0.997, 1.012)	1.007 (0.997, 1.017)
24-hr avg Pb	14.1 ng/m ³	1.001 (0.995, 1.007)	1.002 (0.999, 1.005)	0.999 (0.992, 1.006)	1.001 (0.995, 1.007)	1.000 (0.994, 1.006)	1.001 (0.993, 1.010)
Criteria Pollutants							
8-hr max O ₃	28.3 ppb	0.990 (0.953, 1.027)	1.001 (0.978, 1.024)	0.998 (0.958, 1.039)	0.994 (0.959, 1.030)	0.996 (0.959, 1.035)	0.991 (0.949, 1.034)
1-hr max CO	0.7 ppm	1.005 (0.991, 1.018)	1.003 (0.994, 1.013)	1.005 (0.990, 1.020)	1.005 (0.993, 1.018)	1.006 (0.992, 1.020)	1.005 (0.988, 1.022)
1-hr max NO ₂	12.0 ppb	1.010 (0.990, 1.030)	1.007 (0.994, 1.021)	1.007 (0.985, 1.028)	1.012 (0.994, 1.030)	1.014 (0.994, 1.034)	1.013 (0.989, 1.038)
1-hr max SO ₂	24.0 ppb	1.006 (0.997, 1.015)	0.999 (0.993, 1.005)	1.004 (0.993, 1.015)	1.005 (0.996, 1.014)	1.004 (0.994, 1.013)	1.005 (0.993, 1.018)

^aResults provided as rate ratios (95% CI) per interquartile range increase in pollution. ^b“Primary Model” was a 3-day (lags 0-2) distributed lag model with: indicator variables to control for day-of-week, holidays, and to account for one hospital not providing data after April 26, 2002; cubic splines for day of visit with monthly knots; cubic spline for lag 0 maximum temperature with knots placed at the 25th and 75th percentiles; and cubic terms for 1-2 day moving average minimum temperature and 0-2 day moving average dew point temperature. ^c“Lag -1 Pollution” model was the same as the primary model, but included pollutant concentrations on the day after the emergency department visit (lag -1) given pollutant levels on the days of interest (results for lag -1 RRs reported here). ^d“2 Knots per Month” model was the same as the primary model, but included a cubic spline for day of visit with two knots instead of one knot per month. ^e“1 Knot Every 2 Months” model was the same as the primary model, but included a cubic spline for day of visit with one knot every two months instead of one knot every month. ^f“Indicator Lag 0 Max Temp” model was the same as the primary model, but included indicator variables for each degree Celsius of lag 0 max temp instead of a cubic spline. ^g“5-Day Distributed Lag” model was similar to the primary model, but examined pollutant lags 0-4 with control for minimum and dew point temperature adjusted to include the moving average of lags 1-4 and 0-4 respectively. ** = results with p-value<0.05; * = results with 0.05≤p-value<0.10.

Table S4. Comparison of selected single-pollutant model results for cardiovascular disease to those controlling for co-pollutants.^a

Pollutant of Interest (IQR)	PM _{2.5} 24-hr avg (11.1 µg/m ³)	OC 24-hr avg (2.4 µg/m ³)	EC 24-hr avg (0.42 µg/m ³)	Nor 24-hr avg (0.43 ng/m ³)	Hop 24-hr avg (0.24 ng/m ³)
Covariate Pollutant					
Fine Particles and Components					
24-hr avg PM _{2.5}	0.999 (0.981-1.016)^b	1.026 (0.999, 1.055) ^{*c}	1.019 (1.003, 1.034) ^{**d}	1.014 (0.998, 1.031) [*]	1.015 (1.001, 1.030) ^{**}
<i>Major Ions</i>					
24-hr avg SO ₄ ²⁻	1.003 (0.972, 1.034)	1.020 (1.000, 1.040) ^{**}	1.016 (1.002, 1.030) ^{**}	1.014 (0.999, 1.029) [*]	1.013 (1.000, 1.026) ^{**}
24-hr avg NO ₃ ⁻	0.994 (0.971, 1.017)	1.014 (0.995, 1.034)	1.014 (0.999, 1.029) [*]	1.013 (0.997, 1.028)	1.011 (0.998, 1.025) [*]
<i>Carbon</i>					
24-hr avg OC	0.984 (0.957, 1.012)	1.015 (0.997, 1.033)^{*b}	1.018 (0.998, 1.038) [*]	1.015 (0.993, 1.037)	1.017 (0.998, 1.037) [*]
24-hr avg EC	0.993 (0.973, 1.014)	0.997 (0.972, 1.022)	1.016 (1.002, 1.030)^{**b}	1.019 (0.996, 1.041)	1.016 (0.997, 1.036) [*]
<i>n-Alkanes</i>					
24-hr avg Oct	0.998 (0.978, 1.018)	1.016 (0.994, 1.038)	1.010 (0.994, 1.027)	1.015 (0.997, 1.032) [*]	1.016 (1.000, 1.031) ^{**}
24-hr avg Non	1.000 (0.980, 1.020)	1.020 (0.998, 1.042) [*]	1.017 (1.000, 1.033) ^{**}	1.018 (1.001, 1.036) ^{**}	1.019 (1.003, 1.034) ^{**}
<i>Hopanes</i>					
24-hr avg Nor	0.995 (0.975, 1.015)	1.006 (0.981, 1.031)	1.002 (0.983, 1.022)	1.013 (0.998, 1.028)^{*b}	1.011 (0.985, 1.038)
24-hr avg Hop	0.991 (0.971, 1.011)	0.999 (0.974, 1.026)	1.001 (0.981, 1.022)	1.002 (0.971, 1.033)	1.012 (1.000, 1.025)^{*b}
<i>PAHs</i>					
24-hr avg Chry	0.992 (0.972, 1.013)	1.015 (0.992, 1.038)	1.010 (0.993, 1.027)	1.017 (0.998, 1.036) [*]	1.015 (0.999, 1.031) [*]
24-hr avg BbkF	0.992 (0.972, 1.013)	1.012 (0.989, 1.034)	1.008 (0.990, 1.025)	1.014 (0.995, 1.034)	1.013 (0.997, 1.029)
24-hr avg BaP	0.996 (0.977, 1.017)	1.015 (0.993, 1.037)	1.013 (0.994, 1.032)	1.015 (0.997, 1.033)	1.015 (1.000, 1.030) [*]
24-hr avg IcdP	0.995 (0.975, 1.016)	1.011 (0.989, 1.033)	1.009 (0.991, 1.028)	1.013 (0.995, 1.031)	1.012 (0.996, 1.028)
<i>Metals and Metalloids</i>					
24-hr avg Si	0.999 (0.981, 1.018)	1.016 (0.996, 1.035)	1.017 (1.002, 1.033) ^{**}	1.016 (1.000, 1.032) ^{**}	1.014 (1.001, 1.028) ^{**}
24-hr avg K	0.999 (0.980, 1.018)	1.015 (0.995, 1.035)	1.015 (1.000, 1.031) ^{**}	1.016 (1.000, 1.032) [*]	1.014 (1.000, 1.028) ^{**}
24-hr avg Ca	1.000 (0.980, 1.020)	1.020 (0.998, 1.043) [*]	1.019 (1.002, 1.036) ^{**}	1.017 (1.000, 1.035) ^{**}	1.016 (1.001, 1.031) ^{**}
24-hr avg Fe	1.005 (0.985, 1.024)	1.018 (0.997, 1.040) [*]	1.018 (1.000, 1.035) ^{**}	1.019 (1.001, 1.037) ^{**}	1.016 (1.001, 1.032) ^{**}
24-hr avg Cu	0.998 (0.980, 1.017)	1.015 (0.997, 1.034)	1.017 (1.002, 1.032) ^{**}	1.016 (1.000, 1.032) [*]	1.013 (1.000, 1.027) ^{**}
24-hr avg Zn	0.995 (0.976, 1.014)	1.012 (0.992, 1.032)	1.014 (0.999, 1.030) [*]	1.013 (0.996, 1.030)	1.011 (0.997, 1.025)
24-hr avg Pb	0.997 (0.979, 1.016)	1.014 (0.996, 1.033)	1.016 (1.001, 1.032) ^{**}	1.015 (0.999, 1.032) [*]	1.013 (0.999, 1.026) [*]
Criteria Pollutants					
8-hr max O ₃	1.004 (0.985, 1.024)	1.019 (1.000, 1.039) ^{**}	1.018 (1.003, 1.032) ^{**}	1.014 (0.999, 1.029) [*]	1.013 (1.000, 1.026) [*]
1-hr max CO	0.991 (0.972, 1.010)	1.009 (0.986, 1.033)	1.011 (0.992, 1.031)	1.009 (0.987, 1.032)	1.010 (0.992, 1.029)
1-hr max NO ₂	0.991 (0.970, 1.012)	1.011 (0.988, 1.033)	1.014 (0.998, 1.030) [*]	1.009 (0.992, 1.026)	1.011 (0.996, 1.026)
1-hr max SO ₂	0.996 (0.979, 1.014)	1.014 (0.996, 1.032)	1.015 (1.001, 1.029) ^{**}	1.011 (0.996, 1.026)	1.011 (0.998, 1.024) [*]

^aResults provided as rate ratios (95% CI) per interquartile range increase in the pollutant of interest indicated in the column heading, controlling for the ‘covariate’ pollutant indicated at the beginning of the row; Models were 3-day (lags 0-2) distributed lag models with: the ‘covariate’ pollutant, indicator variables to control for day-of-week, holidays, and to account for one hospital not providing data after April 26, 2002; cubic splines for day of visit with monthly knots; cubic spline for lag 0 maximum temperature with knots placed at the 25th and 75th percentiles; and cubic terms for 1-2 day moving average minimum temperature and 0-2 day moving average dew point temperature; Pollutants of interest for testing in two-pollutant models selected if they had a single-pollutant RR that was equal to or greater than the smallest statistically significant single-pollutant RR greater than 1 for cardiovascular disease (i.e., from results in Table 3 for CVD: RR≥1.012 per IQR, plus PM_{2.5}). ^bRefers to the single-pollutant effect (in bold font). ^cControlling for the non-OC portion of PM_{2.5} produced similar results [RR for OC of 1.023 (95% CI: 1.000, 1.047) per IQR, with 0.05≤p-value<0.10] as controlling for total PM_{2.5}. ^dControlling for the non-EC portion of PM_{2.5} produced similar results [RR for EC of 1.018 (95% CI: 1.003, 1.033) per IQR, with p-value<0.05] as controlling for total PM_{2.5}. ** = results with p-value<0.05; * = results with 0.05≤p-value<0.10.

Table S5. Sensitivity analyses of associations between congestive heart failure emergency department visits and ambient pollutants in St. Louis, 6/1/2001-4/30/2003.^a

Pollutant	IQR	Primary Model ^b	Lag -1 Pollution ^c	2 Knots per Month ^d	1 Knot Every 2 Months ^e	Indicator Lag 0 Maximum Temp ^f	5-Day Distributed Lag ^g
Fine Particles and Components							
24-hr avg PM _{2.5}	11.1 µg/m ³	1.015 (0.980, 1.051)	1.008 (0.978, 1.039)	1.001 (0.963, 1.039)	1.021 (0.989, 1.055)	1.012 (0.976, 1.049)	1.009 (0.967, 1.054)
<i>Major Ions</i>							
24-hr avg SO ₄ ²⁻	3.2 µg/m ³	1.008 (0.980, 1.036)	1.012 (0.984, 1.040)	0.997 (0.968, 1.028)	1.012 (0.985, 1.040)	1.005 (0.976, 1.034)	1.003 (0.969, 1.038)
24-hr avg NO ₃ ⁻	2.3 µg/m ³	1.007 (0.967, 1.050)	0.998 (0.970, 1.027)	0.986 (0.942, 1.031)	1.012 (0.975, 1.051)	1.006 (0.964, 1.049)	1.013 (0.962, 1.066)
<i>Carbon</i>							
24-hr avg OC	2.4 µg/m ³	1.036 (1.001, 1.072)**	1.006 (0.982, 1.031)	1.032 (0.995, 1.071)*	1.041 (1.007, 1.075)**	1.038 (1.001, 1.076)**	1.056 (1.011, 1.104)**
24-hr avg EC	0.42 µg/m ³	1.042 (1.014, 1.070)**	1.005 (0.984, 1.026)	1.041 (1.011, 1.073)**	1.045 (1.018, 1.073)**	1.044 (1.015, 1.073)**	1.046 (1.008, 1.086)**
<i>n-Alkanes</i>							
24-hr avg Oct	0.77 ng/m ³	1.008 (0.995, 1.020)	1.003 (0.991, 1.015)	1.009 (0.995, 1.024)	1.008 (0.997, 1.020)	1.007 (0.995, 1.020)	1.011 (0.992, 1.029)
24-hr avg Non	1.98 ng/m ³	1.002 (0.985, 1.020)	1.007 (0.994, 1.019)	1.003 (0.982, 1.025)	0.999 (0.984, 1.015)	1.003 (0.985, 1.021)	1.010 (0.988, 1.031)
<i>Hopanes</i>							
24-hr avg Nor	0.43 ng/m ³	1.023 (0.994, 1.052)	1.018 (0.998, 1.038)*	1.026 (0.996, 1.058)*	1.025 (0.998, 1.054)*	1.026 (0.996, 1.056)*	1.033 (0.994, 1.074)
24-hr avg Hop	0.24 ng/m ³	1.023 (0.999, 1.048)*	1.015 (0.999, 1.031)*	1.023 (0.997, 1.050)*	1.025 (1.002, 1.048)**	1.027 (1.001, 1.053)**	1.032 (0.998, 1.066)*
<i>PAHs</i>							
24-hr avg Chry	0.39 ng/m ³	1.013 (0.985, 1.041)	1.012 (0.992, 1.032)	1.012 (0.983, 1.042)	1.018 (0.992, 1.045)	1.017 (0.988, 1.046)	0.997 (0.959, 1.037)
24-hr avg BbqF	0.61 ng/m ³	1.021 (0.995, 1.047)	1.012 (0.993, 1.031)	1.017 (0.989, 1.046)	1.026 (1.002, 1.052)**	1.022 (0.995, 1.050)	1.011 (0.974, 1.048)
24-hr avg BaP	0.19 ng/m ³	1.007 (0.994, 1.020)	1.002 (0.993, 1.011)	1.002 (0.987, 1.017)	1.006 (0.994, 1.018)	1.006 (0.993, 1.020)	1.009 (0.992, 1.027)
24-hr avg IcdP	0.27 ng/m ³	1.018 (0.996, 1.040)	1.011 (0.996, 1.026)	1.014 (0.990, 1.039)	1.021 (1.000, 1.042)**	1.019 (0.997, 1.042)*	1.016 (0.986, 1.046)
<i>Metals and Metalloids</i>							
24-hr avg Si	70.2 ng/m ³	0.998 (0.990, 1.007)	1.005 (0.995, 1.015)	0.999 (0.989, 1.009)	0.997 (0.988, 1.006)	0.999 (0.989, 1.008)	0.993 (0.974, 1.012)
24-hr avg K	35.5 ng/m ³	1.002 (0.983, 1.022)	1.008 (0.988, 1.028)	1.001 (0.981, 1.022)	1.000 (0.982, 1.018)	1.001 (0.982, 1.021)	1.008 (0.980, 1.036)
24-hr avg Ca	86.0 ng/m ³	1.021 (0.993, 1.050)	1.010 (0.992, 1.028)	1.022 (0.992, 1.054)	1.014 (0.987, 1.040)	1.021 (0.992, 1.050)	1.021 (0.986, 1.058)
24-hr avg Fe	85.9 ng/m ³	1.006 (0.984, 1.029)	1.017 (0.999, 1.036)*	1.001 (0.977, 1.026)	1.003 (0.982, 1.025)	1.006 (0.983, 1.030)	1.002 (0.971, 1.034)
24-hr avg Cu	21.9 ng/m ³	0.994 (0.980, 1.008)	1.000 (0.992, 1.008)	0.992 (0.977, 1.006)	0.992 (0.979, 1.006)	0.991 (0.977, 1.005)	0.996 (0.978, 1.015)
24-hr avg Zn	37.9 ng/m ³	1.017 (1.003, 1.031)**	0.999 (0.991, 1.008)	1.012 (0.998, 1.027)	1.015 (1.001, 1.028)**	1.016 (1.001, 1.031)**	1.015 (0.996, 1.035)
24-hr avg Pb	14.1 ng/m ³	0.997 (0.985, 1.009)	1.004 (0.998, 1.010)	0.993 (0.979, 1.007)	0.998 (0.986, 1.010)	0.994 (0.982, 1.007)	1.003 (0.986, 1.020)
Criteria Gases							
8-hr max O ₃	28.3 ppb	1.057 (0.982, 1.139)	1.045 (0.998, 1.093)*	1.052 (0.970, 1.140)	1.061 (0.989, 1.138)	1.056 (0.978, 1.140)	1.065 (0.978, 1.160)
1-hr max CO	0.7 ppm	1.015 (0.989, 1.041)	1.015 (0.997, 1.033)	1.011 (0.984, 1.040)	1.023 (0.998, 1.048)*	1.014 (0.988, 1.041)	1.025 (0.993, 1.059)
1-hr max NO ₂	12.0 ppb	1.011 (0.973, 1.050)	1.014 (0.989, 1.041)	1.005 (0.965, 1.048)	1.024 (0.990, 1.059)	1.012 (0.973, 1.053)	1.029 (0.982, 1.077)
1-hr max SO ₂	24.0 ppb	1.006 (0.988, 1.024)	1.005 (0.994, 1.016)	1.001 (0.981, 1.022)	1.007 (0.990, 1.025)	1.001 (0.982, 1.019)	1.003 (0.980, 1.027)

^aResults provided as rate ratios (95% CI) per interquartile range increase in pollution. ^b“Primary Model” was a 3-day (lags 0-2) distributed lag model with: indicator variables to control for day-of-week, holidays, and to account for one hospital not providing data after April 26, 2002; cubic splines for day of visit with monthly knots; cubic spline for lag 0 maximum temperature with knots placed at the 25th and 75th percentiles; and cubic terms for 1-2 day moving average minimum temperature and 0-2 day moving average dew point temperature. ^c“Lag -1 Pollution” model was the same as the primary model, but included pollutant concentrations on the day after the emergency department visit (lag -1) given pollutant levels on the days of interest (results for lag -1 RRs reported here). ^d“2 Knots per Month” model was the same as the primary model, but included a cubic spline for day of visit with two knots instead of one knot per month. ^e“1 Knot Every 2 Months” model was the same as the primary model, but included a cubic spline for day of visit with one knot every two months instead of one knot every month. ^f“Indicator Lag 0 Max Temp” model was the same as the primary model, but included indicator variables for each degree Celsius of lag 0 max temp instead of a cubic spline. ^g“5-Day Distributed Lag” model was similar to the primary model, but examined pollutant lags 0-4 with control for minimum and dew point temperature adjusted to include the moving average of lags 1-4 and 0-4 respectively. ** = results with p-value<0.05; * = results with 0.05≤p-value<0.10.

Table S6. Comparison of selected single-pollutant model results for congestive heart failure to those controlling for co-pollutants.^a

Pollutant of Interest (IQR)	PM _{2.5} 24-hr avg (11.1 µg/m ³)	OC 24-hr avg (2.4 µg/m ³)	EC 24-hr avg (0.42 µg/m ³)	Nor 24-hr avg (0.43 ng/m ³)	Hop 24-hr avg (0.24 ng/m ³)	BbkF 24-hr avg (0.61 ng/m ³)	lcdP 24-hr avg (0.27 ng/m ³)	Ca 24-hr avg (86.0 ng/m ³)	Zn 24-hr avg (37.9 ng/m ³)	O ₃ 8-hr max (28.3 ppb)
Covariate Pollutant										
Fine Particles and Components										
24-hr avg PM _{2.5}	1.015 (0.980, 1.051)^b	1.059 (1.005, 1.117) ^{**c}	1.049 (1.018, 1.080) ^{**d}	1.026 (0.994, 1.059)	1.028 (1.001, 1.057) ^{**}	1.026 (0.996, 1.057) [*]	1.020 (0.996, 1.044)	1.017 (0.986, 1.050)	1.016 (1.002, 1.031) ^{**}	1.031 (0.951, 1.118)
Major Ions										
24-hr avg SO ₄ ²⁻	1.033 (0.972, 1.097)	1.042 (1.004, 1.082) ^{**}	1.042 (1.014, 1.071) ^{**}	1.024 (0.995, 1.053)	1.024 (0.999, 1.049) [*]	1.022 (0.995, 1.049)	1.019 (0.997, 1.041) [*]	1.021 (0.993, 1.050)	1.017 (1.003, 1.031) ^{**}	1.054 (0.966, 1.149)
24-hr avg NO ₃ ⁻	1.024 (0.979, 1.072)	1.046 (1.007, 1.087) ^{**}	1.049 (1.020, 1.080) ^{**}	1.031 (1.000, 1.063) ^{**}	1.028 (1.003, 1.055) ^{**}	1.021 (0.992, 1.051)	1.019 (0.994, 1.044)	1.023 (0.995, 1.053)	1.017 (1.003, 1.032) ^{**}	1.047 (0.968, 1.131)
Carbon										
24-hr avg OC	0.973 (0.920, 1.029)	1.036 (1.001, 1.072)^{b***}	1.048 (1.008, 1.089) ^{**}	1.006 (0.965, 1.049)	1.015 (0.977, 1.054)	1.012 (0.977, 1.047)	1.003 (0.973, 1.034)	1.017 (0.980, 1.055)	1.012 (0.997, 1.028)	1.025 (0.947, 1.111)
24-hr avg EC	0.990 (0.950, 1.031)	0.990 (0.942, 1.041)	1.042 (1.014, 1.070)^{b***}	1.000 (0.958, 1.044)	1.001 (0.964, 1.040)	1.011 (0.976, 1.047)	0.996 (0.964, 1.028)	1.011 (0.976, 1.047)	1.009 (0.994, 1.025)	1.036 (0.958, 1.120)
n-Alkanes										
24-hr avg Oct	0.999 (0.961, 1.039)	1.031 (0.988, 1.076)	1.032 (1.000, 1.065) [*]	1.014 (0.981, 1.049)	1.019 (0.990, 1.049)	1.009 (0.978, 1.041)	1.007 (0.982, 1.032)	1.025 (0.991, 1.059)	1.014 (1.000, 1.029) [*]	1.041 (0.962, 1.128)
24-hr avg Non	1.009 (0.971, 1.048)	1.047 (1.004, 1.093) ^{**}	1.046 (1.013, 1.080) ^{**}	1.026 (0.993, 1.06)	1.029 (1.000, 1.059) [*]	1.026 (0.996, 1.057) [*]	1.019 (0.994, 1.044)	1.036 (1.002, 1.071) ^{**}	1.017 (1.003, 1.032) ^{**}	1.032 (0.955, 1.116)
Hopanes										
24-hr avg Nor	1.001 (0.962, 1.040)	1.035 (0.986, 1.086)	1.041 (1.001, 1.082) ^{**}	1.023 (0.994, 1.052)^b	1.029 (0.977, 1.083)	1.013 (0.980, 1.047)	1.009 (0.983, 1.036)	1.029 (0.995, 1.063) [*]	1.014 (0.999, 1.029) [*]	1.036 (0.957, 1.122)
24-hr avg Hop	0.995 (0.957, 1.036)	1.024 (0.973, 1.077)	1.040 (0.999, 1.082) [*]	0.993 (0.935, 1.055)	1.023 (0.999, 1.048)^{b*}	1.011 (0.979, 1.043)	1.008 (0.981, 1.035)	1.025 (0.990, 1.060)	1.013 (0.999, 1.028) [*]	1.036 (0.958, 1.120)
PAHs										
24-hr avg Chry	1.007 (0.966, 1.048)	1.043 (0.999, 1.090) [*]	1.041 (1.007, 1.076) ^{**}	1.023 (0.987, 1.061)	1.026 (0.996, 1.057) [*]	1.061 (0.993, 1.134) [*]	1.022 (0.993, 1.053)	1.031 (0.998, 1.064) [*]	1.016 (1.001, 1.031) ^{**}	1.052 (0.974, 1.137)
24-hr avg BbkF	0.998 (0.959, 1.040)	1.028 (0.985, 1.074)	1.033 (0.998, 1.069) [*]	1.015 (0.978, 1.053)	1.019 (0.988, 1.050)	1.021 (0.995, 1.047)^b	1.014 (0.980, 1.049)	1.027 (0.995, 1.060)	1.015 (1.000, 1.030) ^{**}	1.057 (0.978, 1.141)
24-hr avg BaP	1.006 (0.967, 1.047)	1.033 (0.990, 1.078)	1.042 (1.005, 1.081) ^{**}	1.021 (0.986, 1.056)	1.023 (0.994, 1.053)	1.024 (0.979, 1.072)	1.019 (0.988, 1.052)	1.031 (0.998, 1.065) [*]	1.017 (1.002, 1.033) ^{**}	1.053 (0.974, 1.139)
24-hr avg lcdP	1.007 (0.967, 1.048)	1.036 (0.993, 1.081)	1.043 (1.007, 1.081) ^{**}	1.017 (0.983, 1.054)	1.018 (0.988, 1.049)	1.007 (0.966, 1.049)	1.018 (0.996, 1.040)^b	1.027 (0.994, 1.061)	1.016 (1.001, 1.031) ^{**}	1.050 (0.971, 1.136)
Metals and Metalloids										
24-hr avg Si	1.021 (0.985, 1.059)	1.031 (0.994, 1.070)	1.042 (1.012, 1.072) ^{**}	1.023 (0.993, 1.054)	1.022 (0.997, 1.048) [*]	1.018 (0.991, 1.046)	1.019 (0.994, 1.045)	1.035 (1.002, 1.068) ^{**}	1.017 (1.003, 1.032) ^{**}	1.052 (0.973, 1.137)
24-hr avg K	1.017 (0.980, 1.057)	1.035 (0.996, 1.076) [*]	1.048 (1.018, 1.079) ^{**}	1.025 (0.994, 1.057)	1.025 (0.999, 1.052) [*]	1.019 (0.991, 1.048)	1.020 (0.994, 1.046)	1.024 (0.992, 1.057)	1.017 (1.003, 1.032) ^{**}	1.045 (0.967, 1.129)
24-hr avg Ca	1.012 (0.974, 1.053)	1.029 (0.985, 1.074)	1.043 (1.010, 1.077) ^{**}	1.018 (0.985, 1.051)	1.019 (0.991, 1.048)	1.016 (0.987, 1.045)	1.016 (0.990, 1.043)	1.021 (0.993, 1.050)^b	1.015 (1.001, 1.030) ^{**}	1.041 (0.962, 1.125)
24-hr avg Fe	1.023 (0.984, 1.062)	1.026 (0.984, 1.069)	1.040 (1.005, 1.076) ^{**}	1.015 (0.981, 1.050)	1.018 (0.989, 1.047)	1.010 (0.978, 1.044)	1.015 (0.986, 1.046)	1.028 (0.991, 1.066)	1.017 (1.003, 1.032) ^{**}	1.054 (0.976, 1.138)
24-hr avg Cu	1.019 (0.984, 1.056)	1.041 (1.005, 1.079) ^{**}	1.050 (1.021, 1.079) ^{**}	1.030 (1.000, 1.061) [*]	1.028 (1.003, 1.054) ^{**}	1.023 (0.996, 1.051) [*]	1.023 (0.998, 1.049) [*]	1.021 (0.993, 1.050)	1.019 (1.005, 1.034) ^{**}	1.051 (0.973, 1.135)
24-hr avg Zn	1.011 (0.975, 1.049)	1.029 (0.991, 1.069)	1.042 (1.011, 1.073) ^{**}	1.017 (0.985, 1.050)	1.021 (0.995, 1.047)	1.015 (0.988, 1.044)	1.017 (0.992, 1.044)	1.012 (0.984, 1.042)	1.017 (1.003, 1.031)^{b***}	1.045 (0.968, 1.128)
24-hr avg Pb	1.022 (0.986, 1.060)	1.043 (1.006, 1.081) ^{**}	1.055 (1.025, 1.086) ^{**}	1.031 (1.000, 1.064) [*]	1.029 (1.003, 1.056) ^{**}	1.026 (0.998, 1.055) [*]	1.026 (1.000, 1.053) [*]	1.023 (0.995, 1.053)	1.023 (1.007, 1.038) ^{**}	1.053 (0.976, 1.137)
Criteria Gases										
8-hr max O ₃	1.015 (0.977, 1.054)	1.042 (1.004, 1.080) ^{**}	1.048 (1.020, 1.078) ^{**}	1.025 (0.996, 1.055) [*]	1.025 (0.999, 1.050) [*]	1.023 (0.997, 1.050) [*]	1.019 (0.998, 1.041) [*]	1.023 (0.994, 1.054)	1.019 (1.005, 1.033) ^{**}	1.057 (0.982, 1.139)^b
1-hr max CO	1.005 (0.968, 1.043)	1.024 (0.979, 1.071)	1.036 (0.999, 1.075) [*]	0.999 (0.958, 1.042)	1.009 (0.975, 1.045)	1.009 (0.975, 1.043)	1.010 (0.982, 1.039)	1.013 (0.982, 1.045)	1.001 (0.977, 1.024)	1.085 (1.006, 1.171) ^{**}
1-hr max NO ₂	1.015 (0.973, 1.058)	1.054 (1.009, 1.100) ^{**}	1.049 (1.018, 1.081) ^{**}	1.021 (0.989, 1.054)	1.022 (0.993, 1.051)	1.019 (0.992, 1.048)	1.018 (0.995, 1.042)	1.044 (1.008, 1.081) ^{**}	1.017 (1.002, 1.031) ^{**}	1.022 (0.941, 1.112)
1-hr max SO ₂	1.014 (0.979, 1.051)	1.036 (1.001, 1.073) ^{**}	1.042 (1.014, 1.070) ^{**}	1.022 (0.993, 1.052)	1.022 (0.997, 1.047) [*]	1.020 (0.994, 1.047)	1.018 (0.996, 1.040)	1.018 (0.989, 1.047)	1.017 (1.003, 1.032) ^{**}	1.057 (0.981, 1.139)

^aResults provided as rate ratios (95% CI) per interquartile range increase in the pollutant of interest indicated in the column heading, controlling for the ‘covariate’ pollutant indicated at the beginning of the row; Models were 3-day (lags 0-2) distributed lag models with: the ‘covariate’ pollutant, indicator variables to control for day-of-week, holidays, and to account for one hospital not providing data after April 26, 2002; cubic splines for day of visit with monthly knots; cubic spline for lag 0 maximum temperature with knots placed at the 25th and 75th percentiles; and cubic terms for 1-2 day moving average minimum temperature and 0-2 day moving average dew point temperature; Pollutants of interest for testing in two-pollutant models selected if they had a single-pollutant RR that was equal to or greater than the smallest statistically significant single-pollutant RR greater than 1 for congestive heart failure (i.e., from results in Table 3 for CHF: $RR \geq 1.017$ per IQR, plus $PM_{2.5}$).

^bRefers to the single-pollutant effect (in bold font). ^cControlling for the non-OC portion of $PM_{2.5}$ produced similar results [RR for OC of 1.053 (95% CI: 1.007, 1.101) per IQR, with p-value<0.05] as controlling for total $PM_{2.5}$. ^dControlling for the non-EC portion of $PM_{2.5}$ produced similar results [RR for EC of 1.048 (95% CI: 1.018, 1.079) per IQR, with p-value<0.05] as controlling for total $PM_{2.5}$. ** = results with p-value<0.05; * = results with $0.05 \leq p\text{-value} < 0.10$.

Table S7. Sensitivity analyses of associations between asthma/wheeze emergency department visits and ambient pollutants in St. Louis, 6/1/2001-4/30/2003.^a

Pollutant	IQR	Primary Model ^b	Lag -1 Pollution ^c	2 Knots per Month ^d	1 Knot Every 2 Months ^e	Indicator Lag 0 Maximum Temp ^f	5-Day Distributed Lag ^g
Fine Particles and Components							
24-hr avg PM _{2.5}	11.1 µg/m ³	1.040 (1.009, 1.071)**	1.022 (0.996, 1.048)*	1.017 (0.986, 1.050)	1.030 (1.002, 1.060)**	1.037 (1.006, 1.069)**	1.047 (1.008, 1.087)**
<i>Major Ions</i>							
24-hr avg SO ₄ ²⁻	3.2 µg/m ³	1.029 (1.004, 1.055)**	1.019 (0.995, 1.043)	1.015 (0.990, 1.041)	1.024 (1.000, 1.049)*	1.029 (1.003, 1.055)**	1.033 (1.001, 1.067)**
24-hr avg NO ₃ ⁻	2.3 µg/m ³	1.011 (0.977, 1.046)	1.020 (0.996, 1.045)*	0.991 (0.956, 1.028)	1.003 (0.971, 1.035)	1.010 (0.975, 1.046)	1.013 (0.970, 1.057)
<i>Carbon</i>							
24-hr avg OC	2.4 µg/m ³	1.029 (1.000, 1.060)*	1.010 (0.989, 1.031)	1.015 (0.985, 1.046)	1.018 (0.990, 1.047)	1.032 (1.001, 1.064)**	1.044 (1.005, 1.084)**
24-hr avg EC	0.42 µg/m ³	1.020 (0.998, 1.044)*	1.011 (0.994, 1.028)	1.005 (0.981, 1.030)	1.015 (0.992, 1.038)	1.020 (0.996, 1.045)	1.043 (1.010, 1.077)**
<i>n-Alkanes</i>							
24-hr avg Oct	0.77 ng/m ³	1.003 (0.993, 1.013)	1.000 (0.991, 1.009)	1.001 (0.989, 1.013)	1.003 (0.993, 1.012)	1.004 (0.994, 1.015)	0.998 (0.983, 1.013)
24-hr avg Non	1.98 ng/m ³	1.003 (0.989, 1.018)	0.997 (0.987, 1.008)	1.001 (0.984, 1.018)	1.002 (0.989, 1.015)	1.005 (0.990, 1.020)	1.002 (0.984, 1.021)
<i>Hopanes</i>							
24-hr avg Nor	0.43 ng/m ³	1.011 (0.988, 1.036)	0.998 (0.982, 1.014)	1.002 (0.978, 1.027)	1.004 (0.981, 1.027)	1.011 (0.986, 1.036)	1.018 (0.986, 1.052)
24-hr avg Hop	0.24 ng/m ³	1.027 (1.006, 1.047)**	1.000 (0.987, 1.014)	1.012 (0.991, 1.033)	1.019 (1.000, 1.039)**	1.031 (1.009, 1.052)**	1.036 (1.008, 1.065)**
<i>PAHs</i>							
24-hr avg Chry	0.39 ng/m ³	1.018 (0.995, 1.042)	1.009 (0.992, 1.026)	1.012 (0.988, 1.037)	1.020 (0.998, 1.043)*	1.019 (0.995, 1.045)	1.016 (0.984, 1.050)
24-hr avg BbkF	0.61 ng/m ³	1.017 (0.996, 1.039)	1.008 (0.993, 1.024)	1.010 (0.987, 1.032)	1.018 (0.998, 1.040)*	1.016 (0.994, 1.039)	1.014 (0.984, 1.045)
24-hr avg BaP	0.19 ng/m ³	1.006 (0.996, 1.017)	1.004 (0.997, 1.010)	0.998 (0.987, 1.010)	1.006 (0.996, 1.016)	1.005 (0.994, 1.016)	1.010 (0.996, 1.024)
24-hr avg IcdP	0.27 ng/m ³	1.013 (0.996, 1.031)	1.009 (0.997, 1.021)	1.001 (0.982, 1.020)	1.011 (0.994, 1.029)	1.013 (0.995, 1.032)	1.028 (1.004, 1.054)**
<i>Metals and Metalloids</i>							
24-hr avg Si	70.2 ng/m ³	1.002 (0.994, 1.010)	1.007 (0.998, 1.016)	1.002 (0.993, 1.010)	1.001 (0.993, 1.009)	1.003 (0.995, 1.011)	1.007 (0.991, 1.024)
24-hr avg K	35.5 ng/m ³	1.012 (0.994, 1.029)	0.995 (0.978, 1.012)	1.008 (0.989, 1.026)	1.007 (0.991, 1.024)	1.011 (0.993, 1.029)	1.027 (1.003, 1.053)**
24-hr avg Ca	86.0 ng/m ³	1.024 (1.001, 1.048)**	1.011 (0.996, 1.027)	1.012 (0.988, 1.038)	1.021 (0.998, 1.044)*	1.020 (0.996, 1.046)	1.053 (1.022, 1.085)**
24-hr avg Fe	85.9 ng/m ³	1.014 (0.994, 1.034)	1.008 (0.993, 1.024)	1.004 (0.983, 1.025)	1.011 (0.992, 1.030)	1.014 (0.993, 1.034)	1.044 (1.017, 1.072)**
24-hr avg Cu	21.9 ng/m ³	1.000 (0.989, 1.011)	0.993 (0.987, 1.000)**	1.006 (0.994, 1.017)	0.998 (0.987, 1.009)	0.998 (0.987, 1.010)	1.001 (0.987, 1.016)
24-hr avg Zn	37.9 ng/m ³	0.993 (0.981, 1.006)	0.999 (0.992, 1.007)	0.988 (0.975, 1.001)*	0.992 (0.980, 1.004)	0.992 (0.980, 1.005)	1.000 (0.984, 1.016)
24-hr avg Pb	14.1 ng/m ³	1.002 (0.992, 1.013)	1.001 (0.996, 1.007)	0.998 (0.987, 1.010)	1.002 (0.992, 1.012)	1.003 (0.992, 1.013)	1.005 (0.991, 1.019)
Criteria Gases							
8-hr max O ₃	28.3 ppb	1.067 (1.001, 1.137)**	0.978 (0.941, 1.016)	1.060 (0.992, 1.133)*	1.066 (1.003, 1.133)**	1.073 (1.005, 1.146)**	1.104 (1.027, 1.188)**
1-hr max CO	0.7 ppm	1.015 (0.993, 1.036)	1.008 (0.993, 1.023)	1.011 (0.989, 1.034)	1.013 (0.993, 1.034)	1.016 (0.994, 1.039)	1.021 (0.993, 1.049)
1-hr max NO ₂	12.0 ppb	1.050 (1.018, 1.084)**	1.010 (0.988, 1.032)	1.037 (1.003, 1.071)**	1.035 (1.005, 1.065)**	1.048 (1.015, 1.083)**	1.081 (1.040, 1.123)**
1-hr max SO ₂	24.0 ppb	0.996 (0.981, 1.011)	1.002 (0.992, 1.011)	0.993 (0.977, 1.010)	1.000 (0.985, 1.015)	0.997 (0.982, 1.013)	1.004 (0.985, 1.024)

^aResults provided as rate ratios (95% CI) per interquartile range increase in pollution. ^b“Primary Model” was a 3-day (lags 0-2) distributed lag model with: indicator variables to control for season, day-of-week, holidays, and to account for one hospital not providing data after April 26, 2002; cubic splines for day of visit with monthly knots; cubic spline for lag 0 maximum temperature with knots placed at the 25th and 75th percentiles; and cubic terms for 1-2 day moving average minimum temperature and 0-2 day moving average dew point temperature. ^c“Lag -1 Pollution” model was the same as the primary model, but included pollutant concentrations on the day after the emergency department visit (lag -1) given pollutant levels on the days of interest (results for lag -1 RRs reported here). ^d“2 Knots per Month” model was the same as the primary model, but included a cubic spline for day of visit with two knots instead of one knot per month. ^e“1 Knot Every 2 Months” model was the same as the primary model, but included a cubic spline for day of visit with one knot every two months instead of one knot every month. ^f“Indicator Lag 0 Max Temp” model was the same as the primary model, but included indicator variables for each degree Celsius of lag 0 max temp instead of a cubic spline. ^g“5-Day Distributed Lag” model was similar to the primary model, but examined pollutant lags 0-4 with control for minimum and dew point temperature adjusted to include the moving average of lags 1-4 and 0-4 respectively. ** = results with p-value<0.05; * = results with 0.05≤p-value<0.10.

Table S8. Comparison of selected single-pollutant model results for asthma/whoeeze to those controlling for co-pollutants.^a

Pollutant of Interest (IQR)	PM _{2.5} 24-hr avg (11.1 µg/m ³)	SO ₄ ²⁻ 24-hr avg (3.2 µg/m ³)	OC 24-hr avg (2.4 µg/m ³)	EC 24-hr avg (0.42 µg/m ³)	Hop 24-hr avg (0.24 ng/m ³)	Ca 24-hr avg (86.0 ng/m ³)	O ₃ 8-hr max (28.3 ppb)	NO ₂ 1-hr max (12.0 ppb)
Covariate Pollutant								
Fine Particles and Components								
24-hr avg PM _{2.5}	1.040 (1.009, 1.071) ^{b,**}	1.001 (0.959, 1.046) ^c	1.011 (0.966, 1.059) ^d	1.013 (0.987, 1.040) ^e	1.022 (0.999, 1.045)*	1.023 (0.996, 1.050)*	1.058 (0.987, 1.135)	1.052 (1.012, 1.092)**
Major Ions								
24-hr avg SO ₄ ²⁻	1.040 (0.987, 1.095)	1.029 (1.004, 1.055) ^{b,**}	1.021 (0.989, 1.054)	1.019 (0.996, 1.043)	1.025 (1.005, 1.046)**	1.023 (0.999, 1.048)*	1.053 (0.979, 1.133)	1.046 (1.011, 1.082)**
24-hr avg NO ₃ ⁻	1.061 (1.020, 1.103)**	1.031 (1.003, 1.060)**	1.030 (0.997, 1.063)*	1.018 (0.993, 1.043)	1.026 (1.005, 1.048)**	1.020 (0.996, 1.045)	1.055 (0.987, 1.127)	1.052 (1.016, 1.088)**
Carbon								
24-hr avg OC	1.030 (0.981, 1.083)	1.023 (0.994, 1.052)	1.029 (1.000, 1.060) ^{b,*}	1.010 (0.977, 1.044)	1.019 (0.987, 1.051)	1.020 (0.989, 1.052)	1.075 (1.003, 1.152)**	1.058 (1.015, 1.103)**
24-hr avg EC	1.029 (0.992, 1.067)	1.028 (1.001, 1.055)**	1.019 (0.975, 1.064)	1.020 (0.998, 1.044) ^{b,*}	1.028 (0.996, 1.061)*	1.022 (0.992, 1.054)	1.077 (1.006, 1.154)**	1.062 (1.022, 1.103)**
n-Alkanes								
24-hr avg Oct	1.044 (1.010, 1.079)**	1.033 (1.006, 1.060)**	1.038 (1.003, 1.075)**	1.033 (1.006, 1.060)**	1.035 (1.010, 1.060)**	1.030 (1.002, 1.058)**	1.071 (1.001, 1.146)**	1.055 (1.020, 1.092)**
24-hr avg Non	1.045 (1.011, 1.080)**	1.033 (1.006, 1.060)**	1.047 (1.010, 1.084)**	1.033 (1.006, 1.060)**	1.035 (1.010, 1.060)**	1.033 (1.005, 1.061)**	1.077 (1.008, 1.151)**	1.059 (1.024, 1.096)**
Hopananes								
24-hr avg Nor	1.039 (1.004, 1.074)**	1.030 (1.004, 1.057)**	1.048 (1.006, 1.091)**	1.033 (1.000, 1.067)*	1.086 (1.041, 1.134)**	1.031 (1.003, 1.060)**	1.090 (1.018, 1.166)**	1.061 (1.023, 1.099)**
24-hr avg Hop	1.027 (0.993, 1.063)	1.030 (1.003, 1.056)**	1.013 (0.971, 1.058)	1.005 (0.972, 1.039)	1.027 (1.006, 1.047) ^{b,**}	1.019 (0.990, 1.048)	1.080 (1.011, 1.155)**	1.045 (1.008, 1.083)**
PAHs								
24-hr avg Chry	1.040 (1.005, 1.077)**	1.032 (1.006, 1.059)**	1.034 (0.997, 1.073)*	1.025 (0.997, 1.054)*	1.027 (1.002, 1.053)**	1.025 (0.998, 1.053)*	1.076 (1.008, 1.148)**	1.054 (1.018, 1.092)**
24-hr avg BbKF	1.038 (1.003, 1.074)**	1.030 (1.003, 1.056)**	1.033 (0.997, 1.071)*	1.028 (0.999, 1.058)*	1.026 (1.001, 1.052)**	1.026 (0.999, 1.053)*	1.078 (1.010, 1.150)**	1.053 (1.018, 1.090)**
24-hr avg BaP	1.036 (1.002, 1.071)**	1.031 (1.005, 1.058)**	1.032 (0.996, 1.069)*	1.033 (1.003, 1.064)**	1.026 (1.002, 1.051)**	1.022 (0.995, 1.050)	1.078 (1.010, 1.152)**	1.052 (1.017, 1.089)**
24-hr avg IcdP	1.036 (1.002, 1.072)**	1.027 (1.000, 1.053)**	1.032 (0.997, 1.069)*	1.028 (0.999, 1.058)*	1.028 (1.003, 1.054)**	1.023 (0.996, 1.051)*	1.081 (1.013, 1.155)**	1.054 (1.017, 1.091)**
Metals and Metalloids								
24-hr avg Si	1.039 (1.007, 1.072)**	1.030 (1.003, 1.057)**	1.013 (0.982, 1.046)	1.011 (0.986, 1.036)	1.021 (0.999, 1.042)*	1.027 (1.000, 1.055)*	1.065 (0.996, 1.139)*	1.040 (1.003, 1.078)**
24-hr avg K	1.035 (1.001, 1.070)**	1.026 (1.000, 1.053)**	1.015 (0.981, 1.049)	1.013 (0.988, 1.039)	1.020 (0.998, 1.043)*	1.020 (0.993, 1.048)	1.063 (0.994, 1.137)*	1.045 (1.008, 1.083)**
24-hr avg Ca	1.027 (0.993, 1.062)	1.025 (0.999, 1.052)*	1.010 (0.974, 1.048)	1.008 (0.980, 1.036)	1.020 (0.996, 1.044)	1.024 (1.001, 1.048) ^{b,**}	1.059 (0.989, 1.133)*	1.047 (1.006, 1.089)**
24-hr avg Fe	1.034 (1.000, 1.070)*	1.027 (1.001, 1.053)**	1.019 (0.982, 1.056)	1.011 (0.982, 1.042)	1.023 (0.998, 1.048)*	1.025 (0.994, 1.058)	1.066 (0.998, 1.140)*	1.048 (1.007, 1.089)**
24-hr avg Cu	1.041 (1.009, 1.073)**	1.029 (1.004, 1.056)**	1.026 (0.995, 1.058)*	1.019 (0.995, 1.043)	1.028 (1.007, 1.049)**	1.024 (1.000, 1.048)**	1.070 (1.001, 1.143)**	1.051 (1.016, 1.087)**
24-hr avg Zn	1.049 (1.016, 1.083)**	1.030 (1.004, 1.057)**	1.038 (1.005, 1.072)**	1.027 (1.001, 1.053)**	1.033 (1.011, 1.056)**	1.031 (1.006, 1.057)**	1.073 (1.004, 1.147)**	1.056 (1.020, 1.093)**
24-hr avg Pb	1.041 (1.009, 1.074)**	1.029 (1.004, 1.056)**	1.028 (0.997, 1.060)*	1.023 (0.998, 1.049)*	1.026 (1.005, 1.048)**	1.024 (1.000, 1.049)*	1.070 (1.002, 1.143)**	1.050 (1.015, 1.087)**
Criteria Gases								
8-hr max O ₃	1.021 (0.988, 1.054)	1.014 (0.986, 1.043)	1.009 (0.977, 1.041)	1.012 (0.988, 1.036)	1.023 (1.002, 1.044)**	1.015 (0.989, 1.042)	1.067 (1.001, 1.137) ^{b,**}	1.040 (1.003, 1.079)**
1-hr max CO	1.033 (1.000, 1.067)**	1.027 (1.001, 1.052)**	1.038 (0.999, 1.079)*	1.025 (0.993, 1.057)	1.040 (1.010, 1.070)**	1.018 (0.992, 1.046)	1.053 (0.986, 1.125)	1.047 (1.011, 1.085)**
1-hr max NO ₂	1.009 (0.974, 1.045)	1.015 (0.988, 1.043)	0.994 (0.958, 1.030)	1.000 (0.975, 1.026)	1.015 (0.992, 1.039)	1.004 (0.975, 1.034)	1.036 (0.964, 1.114)	1.050 (1.018, 1.084) ^{b,**}
1-hr max SO ₂	1.041 (1.010, 1.073)**	1.030 (1.005, 1.056)**	1.030 (1.000, 1.060)*	1.021 (0.998, 1.044)*	1.027 (1.007, 1.048)**	1.026 (1.001, 1.051)**	1.068 (1.001, 1.139)**	1.052 (1.019, 1.086)**

^aResults provided as rate ratios (95% CI) per interquartile range increase in the pollutant of interest indicated in the column heading, controlling for the ‘covariate’ pollutant indicated at the beginning of the row; Models were 3-day (lags 0-2) distributed lag models with: the ‘covariate’ pollutant, indicator variables to control for season, day-of-week, holidays, and to account for one hospital not providing data after April 26, 2002; cubic splines for day of visit with monthly knots; cubic spline for lag 0 maximum temperature with knots placed at the 25th and 75th percentiles; and cubic terms for 1-2 day moving average minimum temperature and 0-2 day moving average dew point temperature; Pollutants of interest for testing in two-pollutant models selected if they had a single-pollutant RR that was equal to or greater than the smallest statistically significant single-pollutant RR greater than 1 for asthma/wheeze (i.e., from results in Table 4 for asthma/wheeze: $RR \geq 1.020$ per IQR).

^bRefers to the single-pollutant effect (in bold font). ^cControlling for the non-SO₄²⁻ portion of PM_{2.5} produced a slightly higher RR [RR for SO₄²⁻ of 1.017 (95% CI: 0.987, 1.047) per IQR] than controlling for total PM_{2.5}. ^dControlling for the non-OC portion of PM_{2.5} produced similar results [RR for OC of 1.017 (95% CI: 0.979, 1.058) per IQR] as controlling for total PM_{2.5}. ^eControlling for the non-EC portion of PM_{2.5} produced similar results [RR for EC of 1.015 (95% CI: 0.989, 1.041) per IQR] as controlling for total PM_{2.5}. ** = results with p-value<0.05; * = results with 0.05≤p-value<0.10.