Environ Health Perspect

DOI: 10.1289/EHP11112

Supplemental Material

Short-Term Association between Sulfur Dioxide and Mortality: A Multicountry Analysis in 399 Cities

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Figure S1. Country-specific exposure-response association between short-term exposure to sulfur dioxide (SO_2, in $\mu g/m^3$) and mortality (as best linear unbiased predictions) estimated from models using a linear term (red) and a quintic polynomial (blue). See the main text for the model definitions. The estimated relationships are shown within a range 0-100 $\mu g/m^3$, with 95% confidence intervals. The analysis includes data from 399 cities within the study period 1980-2018.

Information on country-specific datasets

Australia (2 cities, 2000-2009)

Daily mortality, gathered from the Australian Bureau of Statistics, is represented by counts of deaths due to non-external causes (ICD-9: 0-799; ICD-10: A00-R99). Mean daily temperature (˚C) was obtained from the Australian Bureau of Meteorology. Hourly measurements of carbon monoxide (CO), particulate matter with an aerodynamic diameter of 10 μm or less (PM10), particulate matter with an aerodynamic diameter of 2.5 μm or less (PM2.5), nitrogen dioxide (NO2), sulfur dioxide (SO2), and ozone (O3) were collected from urban monitoring stations run by local EPA. Daily CO, PM10, PM2.5, NO2, and SO2 measurements were computed as 24-h average and daily maximum 8-h average for O3.

Brazil (1 city, 1997 -2011)

Daily mortality was obtained from the Ministry of Health as non-external causes only (ICD-9: 0- 799; ICD-10: A00-R99). Mean daily temperature (in ˚C), computed from the 24-h average of hourly measurements, were weather stations located within the urban area provided by National Institute of Meteorology of Brazil. All pollutant measurements were collected in the field and brought for analysis in the CETESB (Company of Technology of Environmental Sanitation) laboratory. All urban monitors are averaged together to obtain city-wide measurements. Daily measurements for SO2, PM2.5, PM10, NO2, and CO were recorded as 24-h averages.

Canada (24 metropolitan areas, 2000-2015)

Daily mortality, obtained from Statistics Canada through access to the Canadian Mortality Database, is represented by counts of deaths for all causes. Mean daily temperature (in ˚C), computed as the 24-hour average based on hourly measurements, was obtained from Environment Canada. A single weather station was selected for each city using the airport monitoring station located closest to the CMA center. Hourly measures of CO, NO2, SO2, and O3 were collected from monitors located in urban areas of the National Air Pollution Surveillance (NAPS) network of Environment Canada, a government institution that operates ground monitoring stations across Canada. Daily CO, NO2, and SO2 levels were computed as the 24-h average and daily maximum 8-h average for O3 from hourly measurements in different stations, and then averaged across stations within the same CMA with no missing data, with an average of four stations per city.

China (15 cities, 1996-2015)

We collected mortality data from 15 Chinese cities from the Municipal Center for Disease Control. Daily mortality is represented by counts of deaths for non-external causes (ICD-9: 0-799; ICD-10: A00-R99). Mean daily temperature (in ˚C), computed as the 24-hour average from hourly measurements, was collected from the meteorological departments of each city. Measures of CO, PM10, NO2, and SO2 were collected from urban monitoring stations run by China National Environmental Monitoring Center. Daily CO, PM10, NO2, and SO2 levels were computed as the 24-h average.

Colombia (1 city, 1998-2013)

Daily mortality was obtained from the National Administrative Department of Statistics DANE as all-cause. Mean daily temperature (in ˚C), computed as 24-hour average based on hourly measurements, was obtained from Instituto de Hidrología, Meteorología y Estudios Ambientales de Colombia (IDEAM). Daily measurements for SO2, PM2.5, PM10, NO2, and CO were recorded as 24-h averages.

Czech Republic (1 city, 1994-2009)

Daily mortality is represented by counts of all-cause deaths obtained from the Czech Statistical Office and the Institute of Health Information and Statistics. Mean daily temperature (in ˚C) computed as the average of observations in standard climatic terms (7:00, 14:00 and 21:00 local time) was collected by the Czech Hydrometeorological Institute. The average value was calculated according to formula (T07 + T14 + 2*T21)/4. Information about daily SO2, PM10, and NO2 levels computed as 24-hour average and maximum 8-hour average for O3 were provided by the Czech Hydrometeorological Institute. The daily values were calculated from four stations (two urban + two suburban).

Ecuador (1 city, 2014-2018)

Daily mortality was provided by the Instituto Nacional de Estadística y Censos as all-cause. Meterological data were obtained from WMONOAA (Surface Data Hourly Global, DS3505). Twenty four-hour averages are used as daily values for SO2, CO, PM2.5, and NO2.

Estonia (4 cities, 2002-2018)

Daily mortality is represented by counts of deaths for non-external causes (ICD-9: 0-799; ICD10: A00-R99) obtained from Estonian Causes of Death Registry. Mean daily temperature (in ˚C) was computed as the 24-h average of hourly measurements collected from Estonian Environment Agency. A single weather station located nearby the urban area was selected for each city. Hourly measurements PM10, PM2.5, NO2 and O3 were collected from urban background stations run by the Estonian Environmental Research Centre. Daily SO2, PM10, PM2.5 and NO2 levels were computed as 24-hour average and daily maximum 8-hour average for O3; for each pollutant, city average among monitoring stations was calculated. PM10 and NO2 measurements were available between 2009 and 2015 and PM2.5 between 2010 and 2015.

Finland (1 city, 1994-2014)

Data were collected from the Helsinki Metropolitan Area between 1st of January 1994 and 31st of December 2014. Daily number of deaths were obtained from Statistics Finland and are represented by counts of deaths for nonexternal causes (ICD-9: 0-799; ICD-10: A00-R99). A dataset containing weather variables was obtained from Helsinki Region Environmental Services Authority. Measures of SO2, NO2, PM10, PM2.5, and CO were extracted, from a nation-wide dataset compiled by the Finnish Meteorological Institute, for a single coordinate at Helsinki city center using GIS with assistance from Dr. Harri Antikainen, Unit of Geography, University of Oulu, Finland.

Germany (12 cities, 1993-2015)

Daily mortality, obtained from the Research Data Centres of the Federation and the Federal States of Germany (Forschungsdatenzentrum der Statistischen Ämter des Bundes und der Länder), is represented by counts of deaths for all causes. Mean daily temperature (in ˚C), computed as the 24-h average based on hourly measurements, was obtained from the Climate Data Centre of the German National Meteorological Service (Deutscher Wetterdienst). Where several weather stations existed within the city boundaries, stations closest to the city centre were chosen, provided that measurements were available for the whole study period. Hourly measurements of CO, PM10, NO2 and O3 were collected through the German Environment Agency (Umweltbundesamt) from urban background stations. Daily SO2, CO, PM10, and NO2 levels were computed as 24-h average and daily maximum 8-hour average for O3. Measurements were obtained from multiple stations (with different numbers for each city).

Iran (1 city, 2002-2015)

Daily mortality of all causes was provided by the Ferdows organization of Mashhad Municipality. Mean, maximum, and mininum daily temperature (in ˚C) and relative humidity (in %), computed as the 24- hour average based on hourly measurements collected from IRAN Meteorological Organization (IRIMO) (http://www.irimo.ir). Twenty four-hour averages are used as daily values for SO2, CO, PM10, PM2.5, and NO2.

Japan (46 cities, 1979-2015)

Daily mortality, obtained from computerized death certificate data from the Ministry of Health, Labour and Welfare, Japan, is represented by counts of deaths for all causes. Mean daily temperature (in ˚C), computed as the 24-h average based on hourly measurements, was obtained from the Japan Meteorological Agency. A single weather station located within the urban area of the city was selected. Hourly measurements of CO, PM10, NO2, SO2, and O3 were collected from the urban monitors within the capital cities maintained by the Ministry of the Environment of Japan and the National Institute for Environmental Studies. O3 was based on the measurements of photochemical oxidant, which primarily consists of O3. Daily CO, PM10, NO2, and SO2 levels were computed as 24-h average and daily maximum 8-h average for O3.

Peru (1 city, 2010-2014)

Daily mortality of all causes was provided by the Peruvian Ministry of Health (MINSA in Spanish). Mean daily temperature (in ˚C) was obtained from the National Meteorology and Hydrology Service of Peru (SENAMHI in Spanish). Weather stations (one station per region) contributed data to each department series. Twenty four-hour averages are used as daily values for SO2, CO, PM10, PM2.5, and NO2.

Portugal (6 cities, 1995-2018)

Daily mortality, obtained from Statistics Portugal, is represented by counts of deaths for non-external causes only (ICD-9: 0-799; ICD-10: A00-R99). Mean daily temperature (in ˚C) was computed as the 24-h average based on hourly measurements collected from the National Oceanic and Atmospheric Administration (NOAA). Hourly measurements of CO, PM10, NO2, SO2, and O3 were gathered from the “online database of air quality” through Portuguese Environment Agency from urban monitors. Daily CO, PM10, NO2, and SO2 levels were computed as the 24-h average and daily maximum 8-h average for O3 from hourly measurements.

Puerto Rico (1 city, 2009-2016)

Daily mortality of all causes was provided by Instituto de Estadísticas Vitales de Puerto Rico, Área de Estadísticas Vitales del Departamento de Salud. Temperature data was obtained from the Global Historical Climatology Network (NOAA/WMO). Twenty four-hour averages are used as daily values for SO2, CO, and PM10.

Romania (8 cities, 2008-2016)

Daily mortality, obtained from the National Institute for Statistics (NIS) in Romania, is represented by counts of deaths for all causes. The mortality dataset includes the decedents with the stable residence (permanent) or normal residence (defined as the place/city where a person lived mostly in the last 12 months of his/her life) in the seven Romanian cities. Daily mean temperature was obtained from Romanian National Meteorological Administration (RNMA). From 2008, daily CO, PM10, NO2, and SO2 levels were obtained from the National Monitoring and Air Quality Network (RNMCA). All invalid values have been deleted.

South Korea (7 cities, 1999-2015)

Daily mortality was obtained from the Korea National Statistics Office and is represented by counts of deaths for all causes. Mean daily temperature (in ˚C) was computed as the 24-h average based on hourly measurements. Measures of CO, PM10, NO2, SO2, and O3 were available in the period 1999-2015 from monitors of the National Institute of Environmental Research. Daily CO, PM10, NO2, and SO2 levels were computed as the 24-h average and daily maximum 8-h average for O3 from hourly measurements.

Spain (48 cities, 2002-2014)

Daily mortality, obtained from Spain National Institute of Statistics, is represented by counts of deaths for nonexternal causes (ICD-9: 0-799; ICD-10: A00-R99). Mean daily temperature (in ˚C), computed as the 24-h average based on hourly measurements, and was obtained from weather stations of the Spain National Meteorology Agency. A single weather station, located within the urban area or at the near airport, was selected for each city. Hourly measurements of CO, PM10, NO2, SO2, and O3 were collected from the free national repository (Magrama) from urban and suburban monitors. Daily CO, PM10, NO2, and SO2 levels were computed as 24-h average and daily maximum 8-h average for O3.

Switzerland (4 cities, 1995-2013)

Daily mortality, provided by the Federal Office of Statistics (Switzerland), is represented by counts of non-external deaths other than accidents (ICD-10codes A00-R99, V01-V99, W00-X59). Mean daily temperature (in °C), computed as the 24-h average based on hourly measurements, was obtained from the IDAWEB database (a service provided by MeteoSwiss, the Swiss Federal Office of Meteorology and Climatology). A single weather station located within or near the urban area was selected for each city. Hourly measurements of CO, PM10, NO2, SO2, and O3 were provided by the Immissionsdatenbank Luft (IDB, Federal Office of the Environment, Bern, Switzerland). Daily CO, PM10, NO2, and SO2 levels were computed as the 24-h average from urban monitoring stations, and as 8h-maximum for O3 from urban and sub-urban monitoring stations.

Taiwan (3 cities, 1994-2014)

Daily mortality, obtained from the Department of Health in Taiwan, is represented by counts of deaths for all causes. Mean daily temperature (in ˚C) was computed as the 24-h average based on hourly measurements. Hourly measurements of CO, PM10, NO2, SO2, and O3 were obtained from urban monitors of the local monitoring network. Daily CO, PM10, NO2, and SO2 levels were computed as the 24-h average and for O3 as 8- 5 h maximum. Data were pooled from 1 meteorological station and 11 air quality monitoring stations in Kaohsiung, 2 meteorological station and 5 air quality monitoring stations in Taichung, and 3 meteorological station and 15 air quality monitoring stations in Taipei.

Thailand (18 provinces, 1999 -2008)

Daily data on air pollution were obtained from the Pollution Control Department, Ministry of Natural Resources and Environment for 19 cities during 1999-2008 (Air Quality and Noise Management Bureau 2010). For each city and air pollutant, daily concentration was averaged by fixed air quality monitoring stations within the city. If monitored data for an individual pollutant were insufficient to calculate a daily average, all measurements from that day were excluded for that pollutant and monitor.

United Kingdom (31 conurbations, 1990-2016)

Daily mortality, gathered from Office for National Statistics, is represented by counts of deaths for all causes. Mean daily temperature (in ˚C) was obtained from the Meteorological Department obtained from British Atmospheric Data Centre. Series for each city daily mean temperatures were similarly constructed from all meteorological stations providing data for at least 75% of days. Daily CO, PM10, NO2, and SO2 levels were obtained from the Automatic Urban and Rural Network (AURN) repository, the Welsh Air Quality Network (WAQN) archive and the King's College London (KCL) dataset. The urban and sub-urban monitoring stations, within the selected boundaries, were considered. Those classified as “Roadside/Trac”, “Industrial”, “Portable/ Mobile”, “Indoor” were excluded, due to the unrepresentative nature of the average exposure.

United States (163 cities, 1985-2006)

Daily mortality is represented by counts of deaths for all causes. Mean daily temperature (in ˚C), computed as the 24-h average based on hourly measurements, was obtained from the National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA). Hourly measurements of CO, PM10, NO2, SO2, and O3 were gathered from the U.S. Environmental Protection Agency (EPA) Air Quality System (AQS), from urban and sub-urban monitoring stations. Daily CO, PM10, NO2, and SO2 levels were computed as the 24-h average from urban monitoring stations, and as 8-h-maximum for O3 from monitors located in the county or set of contiguous counties in which the city is located. PM10 and PM2.5 were collected between 2005 and 2006, and 2004 and 2006, respectively.

Supplementary tables

Table S1. Descriptive statistics reported by city, including the study period, the distribution of sulfur dioxide (SO_2, in µg/m^3) across cities, and the percentage of days above 40 µg/m^3.

Country/region	City	Period	Average mean and 5th¬-95th range of SO2 (µg/m3)	Percentage of days above 40 µg/m^3 ([a])
Canada	Abbotsford	2000-2015	0.9 (0.0-2.9)	0.0%
Canada	Calgary	2000-2015	4.3 (0.0-10.6)	0.0%
Canada	Edmonton	2000-2015	3.8 (0.4-9.5)	0.0%
Canada	Halifax	2000-2015	14.5 (0.9-40.2)	5.1%
Canada	Hamilton	2000-2015	11.4 (1.0-34.5)	3.1%
Canada	Kingston	2007-2010	2.0 (0.0-5.4)	0.0%
Canada	Kitchener-Waterloo	2000-2006	7.2 (0.3-18.7)	0.2%
Canada	London Ontario	2000-2010	5.7 (0.1-16.4)	0.1%
Canada	Montreal	2000-2015	6.7 (0.7-19.0)	0.3%
Canada	Oakville	2000-2006	8.4 (0.6-23.6)	0.5%
Canada	Ottawa	2000-2015	3.9 (0.0-14.5)	0.1%
Canada	Regina	2000-2013	1.5 (0.0-4.5)	0.0%
Canada	Sarnia	2000-2015	17.7 (0.3-71.5)	11.9%
Canada	Sudbury	2000-2015	6.1 (0.0-24.3)	1.3%
Canada	Saint John NB	2000-2015	7.2 (0.2-27.9)	1.7%
Canada	St. John's NFL	2000-2015	4.1 (0.0-14.3)	0.1%
Canada	Sault Ste. Marie	2000-2015	3.2 (0.0-11.8)	0.3%
Canada	Saskatoon	2000-2015	1.1 (0.0-3.6)	0.0%
Canada	Thunder Bay	2000-2003	1.3 (0.0-5.2)	0.0%
Canada	Toronto	2000-2015	5.4 (0.3-16.5)	0.1%
Canada	Victoria	2000-2015	2.4 (0.4-5.8)	0.0%
Canada	Vancouver	2000-2015	4.5 (0.9-11.0)	0.0%
Canada	Windsor	2000-2015	11.8 (1.0-31.5)	1.9%
Canada	Winnipeg	2009-2015	0.6 (0.0-2.8)	0.0%
USA-Central	Akron	1985-2006	27.1 (3.5-66.1)	21.6%
USA-Central	Chicago	1985-2006	15.1 (3.8-34.0)	2.5%
USA-Central	Charleston (WV)	1985-2006	26.0 (7.0-59.9)	16.4%
USA-Central	Columbus	1985-2006	15.4 (1.6-46.0)	6.8%
USA-Central	Cleveland	1985-2006	21.4 (4.9-50.7)	10.9%
USA-Central	Cincinnati	1985-2006	24.9 (2.7-65.6)	19.7%
USA-Central	Canton	1985-2004	22.7 (4.4-56.0)	13.5%
USA-Central	Dayton	1985-2004	13.9 (1.7-38.5)	4.4%
USA-Central	Evansville	1985-2006	21.3 (3.0-51.8)	11.0%
USA-Central	Ft Wayne	1985-1993	11.8 (4.2-28.4)	1.6%
USA-Central	Gary	1985-2006	16.8 (3.3-41.5)	5.6%
USA-Central	Indianapolis	1985-2006	18.8 (4.3-44.5)	7.3%
USA-Central	Knoxville	1985-2006	18.5 (4.9-43.9)	6.5%
USA-Central	Lafayette (IN)	1987-1996	17.2 (2.6-48.9)	7.5%

USA-Central	Louisville	1985-2006	19.1 (2.8-45.4)	7.6%
USA-Central	LaPorte	1985-2006	14.6 (2.1-37.1)	4.0%
USA-Central	Middletown	1985-2006	18.9 (3.4-48.6)	9.0%
USA-Central	Madison (IL)	1985-2006	22.0 (3.7-54.5)	12.6%
USA-Central	Memphis	1985-2006	14.9 (4.1-37.3)	4.0%
USA-Central	Nashville	1985-2006	20.1 (3.4-43.1)	6.1%
USA-Central	Portage	1985-2006	15.4 (2.8-36.0)	3.6%
USA-Central	Springfied (MO)	1985-2006	10.8 (-2.7-39.6)	4.9%
USA-Central	Steubenville	1985-2006	42.5 (12.5-104.0)	40.4%
USA-Central	Saint Charles	1985-2000	15.3 (2.0-39.9)	5.0%
USA-Central	Saint Clair	1985-2006	22.3 (2.8-60.3)	13.5%
USA-Central	South bend	1985-1992	17.8 (4.2-44.0)	6.7%
USA-Central	St Louis	1985-2006	20.5 (2.5-47.7)	10.0%
USA-Central	Toledo	1985-2006	15.4 (2.2-40.5)	5.2%
USA-Central	Terra Haute	1985-2006	20.2 (3.3-49.7)	9.9%
USA-Central	Youngstown	1985-2006	26.7 (4.2-65.8)	19.9%
USA-NECentral	Cedar Rapids	1985-2006	11.1 (0.0-37.4)	4.3%
USA-NECentral	Detroit	1985-2006	16.8 (1.4-42.2)	6.2%
USA-NECentral	Davenport	1985-2006	8.2 (0.3-22.9)	0.7%
USA-NECentral	Flint	1985-2006	7.6 (0.0-24.5)	0.9%
USA-NECentral	Green Bay	1985-2006	12.9 (2.6-36.4)	3.7%
USA-NECentral	Grand Rapids	1985-2006	6.3 (0.0-18.8)	0.2%
USA-NECentral	Kalamazoo	1991-1996	10.3 (2.4-26.3)	1.0%
USA-NECentral	Kenosha	1985-1992	10.7 (-0.0-37.2)	4.0%
USA-NECentral	Lansing	1985-1988	16.3 (1.9-41.3)	5.4%
USA-NECentral	Madison (WI)	1985-1999	8.9 (2.6-23.4)	1.1%
USA-NECentral	Milwaukee	1985-2006	11.1 (2.8-30.9)	2.4%
USA-NECentral	Minneapolis	1985-2006	7.7 (0.0-23.1)	1.2%
USA-NECentral	Muskegon	1985-1988	12.3 (0.1-35.8)	2.9%
USA-NECentral	Sioux City	2001-2002	2.2 (-0.0-8.6)	0.0%
USA-NorthEast	Albany	1986-2006	16.1 (1.1-52.0)	8.4%
USA-NorthEast	Allentown	1985-2006	22.3 (5.0-54.7)	12.1%
USA-NorthEast	Atlantic City	1985-2006	8.6 (2.6-22.0)	0.6%
USA-NorthEast	Buffalo	1985-2006	23.6 (1.6-58.8)	17.1%
USA-NorthEast	Baltimore	1985-2006	21.1 (4.5-47.2)	9.0%
USA-NorthEast	Bangor	1985-1996	10.6 (0.3-30.2)	1.7%
USA-NorthEast	Bergen	1985-2006	19.0 (3.5-51.1)	9.4%
USA-NorthEast	Burlington	1985-2004	10.9 (2.6-30.4)	1.4%
USA-NorthEast	Boston	1985-2006	19.6 (5.9-49.2)	9.1%
USA-NorthEast	Dover	1985-1993	25.1 (4.4-49.1)	11.4%
USA-NorthEast	Elizabeth	1985-2006	23.0 (5.9-55.2)	12.6%
USA-NorthEast	Erie	1988-2006	27.4 (7.2-62.0)	15.9%
USA-NorthEast	Essex	1985-2002	18.5 (3.9-46.4)	8.0%
USA-NorthEast	Greensburg	1997-2006	20.0 (1.1-46.7)	8.8%

USA-NorthEast	Harrisburg	1985-2006	16.2 (1.9-42.1)	5.9%
USA-NorthEast	Hartford	1985-2006	14.6 (1.0-43.2)	6.0%
USA-NorthEast	Jersey City	1985-2006	24.7 (7.4-57.1)	14.2%
USA-NorthEast	Lancaster	1985-2006	15.1 (1.8-36.7)	3.6%
USA-NorthEast	Middlesex	1985-2006	16.5 (3.3-44.1)	6.4%
USA-NorthEast	Mercer	1985-2006	20.0 (1.7-53.9)	10.7%
USA-NorthEast	Marlborough	1985-2006	22.0 (1.7-57.1)	14.5%
USA-NorthEast	Nashua	1985-2006	15.3 (1.5-43.0)	6.1%
USA-NorthEast	Nassau	1985-2006	18.3 (3.5-50.1)	9.0%
USA-NorthEast	New Haven	1985-2006	19.3 (2.9-54.7)	10.7%
USA-NorthEast	New London	1985-1999	16.8 (3.6-41.7)	6.0%
USA-NorthEast	Newark	1985-2006	17.3 (3.0-45.6)	7.1%
USA-NorthEast	New York	1985-2006	31.4 (8.8-74.7)	25.3%
USA-NorthEast	Philadelphia	1985-2006	20.3 (4.7-50.0)	9.5%
USA-NorthEast	Portland	1985-2006	17.0 (1.8-50.9)	9.2%
USA-NorthEast	Providence	1985-2006	21.7 (3.4-56.4)	12.6%
USA-NorthEast	Pittsburgh	1985-2006	34.6 (8.1-84.8)	30.0%
USA-NorthEast	Rochester	1985-2006	23.3 (3.9-57.8)	15.9%
USA-NorthEast	Reading	1985-2006	24.3 (5.9-55.6)	13.8%
USA-NorthEast	Scranton	1985-2006	18.5 (3.2-51.4)	8.9%
USA-NorthEast	Springfield (MA)	1985-2006	20.3 (3.3-51.7)	10.2%
USA-NorthEast	Stamford	1985-2006	17.7 (2.1-50.4)	9.0%
USA-NorthEast	State College	2002-2006	10.1 (0.0-28.9)	1.1%
USA-NorthEast	Trenton	1985-1991	24.3 (5.6-58.8)	14.8%
USA-NorthEast	Wilmington	1985-2006	24.2 (3.7-55.0)	14.0%
USA-NorthEast	Worcester	1985-2006	15.2 (2.1-40.8)	5.3%
USA-NorthEast	Washington	1985-2006	27.6 (9.7-58.8)	16.1%
USA-NorthEast	York	1985-2006	17.8 (2.6-41.6)	5.8%
USA-NorthWest	Everett	1989-1999	12.2 (3.8-26.9)	0.6%
USA-NorthWest	Portland (OR)	1985-2006	13.2 (2.7-32.3)	1.9%
USA-NorthWest	Seattle	1985-2006	15.9 (3.1-36.0)	3.5%
USA-NorthWest	Tacoma	1987-1999	17.8 (6.5-36.0)	3.4%
USA-NorthWest	Vancouver	1989-1991	13.7 (3.0-30.2)	2.2%
USA-NWCentral	Fargo	1995-2006	1.4 (0.0-5.3)	0.0%
USA-NWCentral	Omaha	1985-2006	4.2 (-0.4-14.1)	0.8%
USA-South	Austin	1985-2006	1.7 (0.0-13.1)	0.1%
USA-South	Brownsville	1993-2000	0.9 (-0.0-7.9)	0.0%
USA-South	Baton Rouge	1985-2006	16.4 (3.5-37.1)	3.9%
USA-South	Corpus Christi	1985-2006	4.0 (-0.5-15.1)	0.2%
USA-South	Dallas	1986-2006	5.0 (0.0-19.2)	0.4%
USA-South	El Paso	1985-2006	18.1 (0.2-68.8)	14.8%
USA-South	Fort Worth	1985-1996	3.1 (-0.0-18.7)	0.3%
USA-South	Houston	1985-2006	9.4 (2.2-20.5)	0.1%
USA-South	Kansas	1985-2006	10.0 (1.0-25.9)	1.5%

USA-South	Lake Charles	1985-2006	8.4 (0.6-23.1)	0.7%
USA-South	Little Rock	1985-2006	6.2 (0.0-16.3)	0.1%
USA-South	Monroe	1985-2006	7.2 (0.0-20.0)	0.8%
USA-South	Oklahoma	1986-2006	8.3 (0.3-24.8)	0.4%
USA-South	Port Arthur	1985-2006	14.7 (-0.0-46.4)	7.3%
USA-South	San Antonio	1985-1988	1.9 (0.0-11.8)	0.0%
USA-South	Tulsa	1985-2006	20.3 (1.4-57.6)	13.8%
USA-South	Wichita	1991-1997	12.5 (6.5-18.0)	0.6%
USA-SouthEast	Augusta	1988-2004	7.5 (2.6-19.5)	0.3%
USA-SouthEast	Annandale	1985-2006	18.8 (6.3-39.5)	4.7%
USA-SouthEast	Atlanta	1985-2006	14.3 (2.6-41.6)	5.5%
USA-SouthEast	Birmingham	1985-2006	15.1 (2.2-38.2)	4.3%
USA-SouthEast	Charlotte	1994-2006	10.0 (1.2-22.8)	0.2%
USA-SouthEast	Charleston (SC)	1985-2006	4.9 (-0.6-18.5)	0.9%
USA-SouthEast	Columbia	1985-2006	4.6 (-0.3-13.8)	0.1%
USA-SouthEast	Fort Lauderdale	1992-2006	4.8 (0.0-14.5)	0.3%
USA-SouthEast	Fayetteville	1990-2006	8.6 (2.1-16.2)	0.0%
USA-SouthEast	Greensboro	1985-1990	12.9 (6.8-30.3)	1.8%
USA-SouthEast	Greenville	1989-2006	5.7 (-0.0-19.1)	0.2%
USA-SouthEast	Honolulu	1990-2006	2.1 (0.3-4.9)	0.0%
USA-SouthEast	Jacksonville	1985-2006	6.1 (0.6-17.1)	0.1%
USA-SouthEast	Lakeland	1986-2005	10.2 (1.7-23.3)	0.4%
USA-SouthEast	Macon	1988-2006	7.3 (2.6-20.1)	0.3%
USA-SouthEast	Miami	1985-2006	2.2 (-0.0-7.0)	0.0%
USA-SouthEast	Montgomery	1995-1998	4.2 (0.0-17.0)	0.7%
USA-SouthEast	Mobile	1985-2006	16.5 (0.0-70.2)	14.1%
USA-SouthEast	Norfolk	1985-2006	15.2 (2.7-34.3)	2.5%
USA-SouthEast	Orlando	1985-2006	3.5 (0.0-11.7)	0.0%
USA-SouthEast	Palm Beach	1988-2006	3.4 (0.0-11.7)	0.2%
USA-SouthEast	Pensacola	1985-2006	11.9 (0.1-47.1)	6.5%
USA-SouthEast	Richmond	1985-2006	14.1 (1.1-37.3)	4.0%
USA-SouthEast	Raleigh	2002-2006	6.1 (0.0-15.5)	0.0%
USA-SouthEast	Sarasota	1987-2006	4.3 (0.0-15.3)	0.4%
USA-SouthEast	St Petersburg	1985-2006	8.1 (-0.6-25.2)	0.7%
USA-SouthEast	Tampa	1985-2006	13.4 (3.1-30.2)	1.4%
USA-SouthEast	Winston	1985-2006	15.6 (3.2-36.5)	3.5%
USA-SouthEast	Washington DC	1985-2006	23.5 (6.4-51.3)	11.3%
USA-SouthWest	Aztec	1985-2006	10.8 (0.5-27.8)	1.0%
USA-SouthWest	Colorado Spring	1988-2001	6.8 (1.7-13.6)	0.0%
USA-SouthWest	Davis	1985-2006	10.9 (0.9-35.7)	4.2%
USA-SouthWest	Denver	1985-2006	11.1 (1.1-27.9)	1.1%
USA-SouthWest	Grand Junction	1988-1992	3.3 (0.0-12.4)	0.0%
USA-SouthWest	Logan	2002-2006	2.4 (0.0-6.7)	0.0%
USA-SouthWest	Phoenix	1985-2006	6.5 (0.4-16.9)	0.1%

USA-SouthWest	Salt Lake City	1985-2006	15.3 (2.4-50.1)	7.7%
USA-SouthWest	Tucson	1985-2006	4.6 (0.3-12.5)	0.1%
USA-West	Anaheim	1985-2006	4.8 (0.0-15.5)	0.0%
USA-West	Bakersfield	1985-2001	8.7 (0.4-23.5)	0.2%
USA-West	El Centro	1994-2006	4.7 (0.0-21.0)	0.4%
USA-West	Fresno	1990-2003	7.1 (0.0-25.0)	0.0%
USA-West	Los Angeles	1985-2006	6.9 (0.9-17.0)	0.0%
USA-West	Las Vegas	1998-2006	2.8 (-0.1-18.3)	0.0%
USA-West	Modesto	1985-1991	3.5 (-0.0-15.9)	0.0%
USA-West	Oakland	1985-2006	3.9 (0.1-8.7)	0.0%
USA-West	Riverside	1985-2006	3.6 (0.1-8.5)	0.0%
USA-West	Sacramento	1985-2006	4.6 (-0.0-16.7)	0.1%
USA-West	San Diego	1985-2006	7.9 (1.0-16.4)	0.0%
USA-West	San Francisco	1986-2006	4.1 (0.0-13.8)	0.0%
USA-West	Stockton	1985-1989	6.6 (0.0-26.2)	0.1%
USA-West	Visalia	1985-1989	3.0 (0.0-13.8)	1.4%
USA-West	Ventura	1986-2004	3.0 (-0.1-12.8)	0.0%
Puerto Rico	San Juan	2009-2016	4.6 (0.0-9.4)	0.7%
Brazil	Sao Paulo	1997-2011	12.3 (4.0-26.3)	0.6%
Colombia	Bogota	1998-2013	20.9 (5.3-41.6)	6.4%
Ecuador	Quito	2014-2018	16.7 (8.0-26.0)	0.2%
Peru	lima	2010-2014	12.8 (3.4-27.8)	0.1%
Estonia	Kohtla-Jarve linn	2002-2018	6.7 (0.2-28.9)	2.5%
Estonia	Narva linn	2009-2018	1.5 (0.2-4.7)	0.0%
Estonia	Tallinn	2005-2018	1.2 (0.1-4.0)	0.0%
Estonia	Tartu linn	2008-2018	1.0 (0.2-2.9)	0.0%
Finland	Helsinki	1994-2014	9.1 (2.1-25.9)	1.0%
UK	Blackpool	2000-2007	9.3 (0.1-24.0)	0.7%
UK	Barnsley/Dearne Valley	1991-2016	31.7 (-6.3-65.3)	18.4%
UK	Birkenhead	2000-2007	8.9 (0.2-26.6)	0.5%
UK	Bournemouth/Poole	2001-2007	2.3 (0.0-6.8)	0.0%
UK	Bristol	1993-2012	7.6 (0.1-24.0)	0.8%
UK	Cardiff	1992-2016	6.0 (0.4-19.6)	0.6%
UK	Coventry	1997-2000	15.3 (5.5-32.0)	2.5%
UK	Kingston upon Hull	1994-2016	8.5 (1.6-24.4)	1.1%
UK	Leicester	1994-2012	6.7 (0.0-23.0)	0.9%
UK	London	1990-2016	9.4 (1.1-34.4)	3.7%
UK	Liverpool	1993-2016	15.6 (0.9-58.8)	10.2%
UK	Medway Towns	1997-2009	6.7 (0.6-17.9)	0.4%
UK	Manchester	1995-2016	4.9 (-2.2-17.9)	0.6%
UK	Northampton	2001-2012	3.0 (0.0-8.3)	0.1%
UK	Norwich	1997-2012	8.3 (0.0-22.2)	0.2%
UK	Nottingham	1996-2016	8.4 (0.7-23.6)	0.9%

UK	Newport	2001-2007	3.4 (0.3-7.2)	0.1%
UK	Plymouth	1997-2007	4.1 (0.0-8.6)	0.0%
UK	Preston	2000-2007	7.5 (0.4-19.2)	0.2%
UK	Reading	1997-2007	5.5 (0.2-13.3)	0.0%
UK	Sheffield	1995-2012	11.6 (1.5-27.9)	2.1%
UK	Sunderland	1992-2012	6.6 (0.1-19.6)	1.3%
UK	South Hampshire	1994-2016	4.9 (0.3-14.1)	0.2%
UK	Southend-on-Sea	2000-2007	7.7 (1.1-16.9)	0.4%
UK	Stoke-on-Trent	1997-2007	12.1 (3.1-25.3)	1.0%
UK	Swansea	1994-2006	10.9 (1.5-31.6)	2.2%
UK	Teesside	1997-2016	10.3 (1.6-26.6)	1.6%
UK	Tyneside	1992-2012	8.7 (0.5-27.4)	2.1%
UK	Wigan	2004-2007	2.9 (0.0-8.4)	0.0%
UK	West Midlands	1992-2016	7.3 (0.4-26.6)	2.2%
UK	West Yorkshire	1993-2016	9.4 (1.4-30.8)	3.2%
Czech Republic	Prague	1994-2009	14.6 (2.0-55.7)	8.6%
Germany	Berlin	1993-2006	11.2 (1.3-40.2)	5.1%
Germany	Bremen	1993-2015	4.8 (1.5-12.6)	0.6%
Germany	Dresden	1993-2015	10.6 (1.1-41.5)	5.4%
Germany	Dortmund	1993-2013	7.1 (1.4-16.6)	0.9%
Germany	Dusseldorf	1993-2012	8.5 (1.5-19.8)	0.9%
Germany	Frankfurt	1993-2008	7.4 (2.7-19.0)	0.9%
Germany	Hamburg	1993-2015	7.3 (1.8-20.8)	1.1%
Germany	Hannover	1993-2007	8.2 (3.0-23.1)	2.4%
Germany	Koeln	1993-2002	9.6 (5.0-23.5)	1.7%
Germany	Leipzig	1994-2002	9.9 (1.0-40.0)	5.0%
Germany	Muenchen	1993-2006	5.2 (2.0-14.7)	0.2%
Germany	Stuttgart	1993-2015	4.6 (0.6-13.4)	0.2%
Romania	Bucharest	2008-2016	11.4 (3.2-26.2)	0.9%
Romania	Brasov	2008-2016	5.3 (2.2-9.6)	0.0%
Romania	Cluj-Napoca	2008-2016	9.3 (4.1-19.1)	0.2%
Romania	Constanta	2008-2016	7.5 (2.6-17.0)	0.0%
Romania	Craiova	2009-2016	13.8 (6.3-29.1)	1.8%
Romania	Galati	2008-2016	3.7 (0.9-10.6)	0.0%
Romania	Iasi	2008-2016	4.7 (2.5-8.7)	0.0%
Romania	Timisoara	2008-2016	11.2 (4.1-21.2)	0.7%
Switzerland	Basel	1995-2013	4.5 (0.5-13.5)	0.1%
Switzerland	Bern	2003-2013	4.8 (0.6-12.3)	0.0%
Switzerland	Lugano	1995-2013	7.9 (0.9-25.1)	0.3%
Switzerland	ZÃ¼rich	1995-2013	5.4 (0.7-16.7)	0.3%
Portugal	Beja	2005-2018	2.8 (1.0-5.8)	0.0%
Portugal	Coimbra	2003-2015	2.1 (0.0-7.2)	0.0%
Portugal	Castelobranco	2003-2018	0.9 (0.0-3.3)	0.0%
Portugal	Faro	2004-2018	6.0 (0.2-15.1)	0.9%

Portugal	Lisboa	1995-2018	2.4 (0.0-9.2)	0.1%
Portugal	Porto	1999-2011	6.9 (1.7-18.8)	0.6%
Spain	A Coruna	2005-2014	5.6 (1.3-12.6)	0.0%
Spain	Albacete	2002-2014	3.8 (2.0-9.2)	0.0%
Spain	Alicante	2002-2014	4.4 (2.5-7.3)	0.0%
Spain	Almeria	2006-2014	7.5 (6.0-9.2)	0.0%
Spain	Avila	2002-2014	4.2 (1.8-6.9)	0.0%
Spain	Badajoz	2002-2014	2.9 (0.4-7.1)	0.0%
Spain	Bilbao	2002-2014	8.3 (4.3-14.5)	0.0%
Spain	Barcelona	2002-2014	3.1 (1.4-6.2)	0.0%
Spain	Burgos	2002-2014	5.3 (2.9-8.3)	0.0%
Spain	Cadiz	2007-2014	6.6 (3.7-10.1)	0.0%
Spain	Caceres	2002-2014	3.5 (0.5-8.4)	0.0%
Spain	Ciudad Real	2008-2014	2.7 (2.0-5.8)	0.0%
Spain	Cordoba	2002-2014	7.4 (5.4-9.7)	0.0%
Spain	Castellon	2002-2014	6.2 (3.4-10.1)	0.0%
Spain	Cuenca	2008-2014	3.8 (2.0-8.7)	0.0%
Spain	Guadalajara	2002-2014	5.8 (2.0-13.9)	0.0%
Spain	Girona	2005-2014	2.9 (1.4-5.6)	0.0%
Spain	Granada	2002-2014	10.1 (6.9-14.8)	0.0%
Spain	Huesca	2003-2014	3.8 (1.0-8.2)	0.0%
Spain	Jaen	2003-2014	5.5 (3.5-8.2)	0.0%
Spain	Leon	2002-2014	8.0 (0.9-22.5)	0.2%
Spain	Logrono	2002-2014	4.0 (1.2-9.3)	0.0%
Spain	Lleida	2002-2014	2.7 (1.0-7.8)	0.0%
Spain	Lugo	2005-2014	5.6 (2.8-10.7)	0.0%
Spain	Malaga	2002-2014	8.3 (5.7-11.4)	0.0%
Spain	Madrid	2002-2014	9.2 (3.8-18.0)	0.0%
Spain	Murcia	2002-2012	6.5 (4.9-8.4)	0.0%
Spain	Ourense	2005-2014	4.4 (1.0-11.5)	0.0%
Spain	Oviedo	2002-2014	15.2 (3.9-39.1)	4.4%
Spain	Palmas G. Canaria	2002-2014	5.9 (2.2-10.3)	0.0%
Spain	Palma Mallorca	2002-2014	3.1 (1.1-6.5)	0.0%
Spain	Palencia	2002-2014	5.1 (3.1-7.8)	0.0%
Spain	Pontevedra	2005-2014	4.4 (1.0-11.2)	0.0%
Spain	Segovia	2002-2014	3.7 (1.9-6.1)	0.0%
Spain	Salamanca	2002-2014	8.0 (3.8-13.8)	0.0%
Spain	San Sebastian	2002-2014	4.5 (2.7-6.7)	0.0%
Spain	Santander	2002-2014	4.1 (1.2-8.2)	0.0%
Spain	Soria	2004-2014	4.0 (1.1-9.2)	0.0%
Spain	Sevilla	2002-2014	5.4 (3.7-7.8)	0.0%
Spain	Teruel	2003-2014	4.4 (1.4-8.5)	0.0%
Spain	Tenerife	2004-2014	10.9 (4.5-18.3)	0.0%
Spain	Toledo	2002-2014	4.8 (3.0-7.2)	0.0%

Spain	Tarragona	2002-2014	3.6 (1.0-9.9)	0.0%
Spain	Vitoria	2002-2014	6.0 (3.9-9.4)	0.0%
Spain	Valladolid	2002-2014	5.3 (3.8-6.9)	0.0%
Spain	Valencia	2002-2014	4.4 (2.2-7.3)	0.0%
Spain	Zamora	2002-2014	4.0 (1.7-7.0)	0.0%
Spain	Zaragoza	2002-2014	7.0 (3.6-13.6)	0.0%
Iran	Tehran	2002-2015	98.9 (17.0-279.1)	70.7%
China	Anshan	2004-2006	54.1 (8.9-192.7)	40.1%
China	Beijing	2007-2015	45.6 (6.9-150.4)	36.2%
China	Fuzhou	2004-2006	15.5 (5.9-27.0)	1.0%
China	Guangzhou	2007-2015	45.8 (13.6-94.0)	51.4%
China	Hong Kong	1996-2002	17.8 (5.5-40.3)	5.2%
China	Hangzhou	2002-2004	49.4 (24.9-88.2)	64.1%
China	Lanzhou	2004-2008	60.2 (19.2-134.7)	63.4%
China	Shanghai	2001-2015	45.9 (17.2-96.1)	47.7%
China	Shenyang	2005-2008	50.4 (14.2-129.0)	44.4%
China	Suzhu	2005-2008	43.4 (18.2-81.9)	50.3%
China	Taiyuan	2004-2008	72.1 (16.4-185.4)	63.2%
China	Tianjin	2005-2008	63.4 (18.2-164.4)	60.9%
China	Wulumuqi	2006-2007	91.2 (15.8-276.0)	54.4%
China	Wuhan	2003-2005	50.0 (17.1-103.8)	58.4%
China	Xian	2004-2008	46.1 (19.6-98.6)	46.4%
Japan	Aikita	2011-2015	6.1 (3.5-9.6)	0.0%
Japan	Aomori	2011-2015	2.4 (0.2-6.0)	0.0%
Japan	Chiba	2011-2015	5.1 (1.6-12.8)	0.0%
Japan	Fukushima	2011-2015	1.7 (0.2-3.7)	0.0%
Japan	Fukuoka	1983-2009	5.7 (2.5-10.6)	0.0%
Japan	Fukui	2011-2015	3.3 (0.8-7.0)	0.0%
Japan	Gifu	2011-2015	2.1 (0.4-5.0)	0.0%
Japan	hiroshima	2011-2015	5.0 (2.0-8.9)	0.0%
Japan	Kagoshima	2011-2015	20.0 (2.8-71.3)	12.5%
Japan	Kumamoto	2011-2015	6.1 (1.8-14.7)	0.0%
Japan	Kanazawa	2011-2015	3.9 (1.5-9.3)	0.0%
Japan	Kobe	2011-2015	8.1 (2.5-15.8)	0.0%
Japan	Kochi	2011-2015	8.5 (3.8-14.5)	0.0%
Japan	Kofu	2011-2015	4.1 (1.5-7.5)	0.0%
Japan	Kitakyushu	1983-2009	4.5 (2.1-7.8)	0.0%
Japan	Kyoto	2011-2015	9.9 (6.3-15.8)	0.0%
Japan	Matsue	2011-2015	3.3 (0.3-9.0)	0.0%
Japan	Maebashi	2011-2015	3.8 (1.2-6.8)	0.0%
Japan	Mito	2011-2015	1.9 (0.2-5.0)	0.0%
Japan	Morioka	2011-2015	1.6 (0.1-4.6)	0.0%
Japan	Matsuyama	2011-2015	10.8 (3.1-21.8)	0.0%
Japan	Miyazaki	2013-2015	6.8 (3.6-13.9)	0.1%

Japan	Nagano	2011-2015	6.3 (2.5-10.8)	0.0%
Japan	Nagoya	1980-2009	6.8 (2.3-13.5)	0.0%
Japan	Naha	2011-2015	5.0 (0.2-21.1)	0.5%
Japan	Nara	2011-2015	9.2 (5.2-15.5)	0.0%
Japan	Nagasaki	2011-2015	4.0 (2.6-7.9)	0.0%
Japan	Niigata	2011-2015	3.5 (1.7-6.2)	0.0%
Japan	Oita	2011-2015	11.6 (6.4-19.1)	0.0%
Japan	Okayama	2011-2015	9.5 (4.8-18.0)	0.0%
Japan	Osaka	1980-2009	8.1 (2.6-17.1)	0.0%
Japan	Saga	2011-2015	4.6 (2.4-8.8)	0.0%
Japan	Saitama	2011-2015	3.8 (1.9-6.3)	0.0%
Japan	Sendai	1984-2009	3.4 (0.3-7.0)	0.0%
Japan	Shizuoka	2011-2015	5.4 (3.1-8.3)	0.0%
Japan	Sapporo	1992-2009	4.4 (2.0-8.7)	0.0%
Japan	Takamatsu	2011-2015	14.0 (6.9-26.4)	0.9%
Japan	Tokushima	2011-2015	3.0 (0.8-6.9)	0.0%
Japan	Tokyo	1980-2009	7.8 (1.6-18.5)	0.0%
Japan	Toyama	2011-2015	2.0 (0.6-3.9)	0.0%
Japan	Tsu	2011-2015	3.8 (1.6-7.1)	0.0%
Japan	Utsunomiya	2011-2015	2.8 (0.2-6.7)	0.0%
Japan	Wakayama	2011-2015	8.4 (3.7-15.8)	0.0%
Japan	Yokohama	2011-2015	7.5 (2.8-15.9)	0.0%
Japan	Yamaguchi	2011-2015	2.4 (0.5-5.5)	0.0%
Japan	Yamagata	2011-2015	11.8 (1.4-24.5)	0.3%
South Korea	Busan	1999-2015	18.2 (8.4-34.1)	2.7%
South Korea	Daegu	1999-2015	15.1 (6.1-31.7)	1.7%
South Korea	Daejeon	1999-2015	12.3 (4.7-25.3)	0.6%
South Korea	Gwangju	1999-2015	11.0 (5.5-21.4)	0.2%
South Korea	Incheon	1999-2015	18.8 (10.6-31.3)	1.0%
South Korea	Seoul	1999-2015	14.3 (7.7-25.6)	0.3%
South Korea	Ulsan	1999-2015	18.9 (9.3-34.3)	2.2%
Thailand	Ayutthaya	1999-2008	7.0 (1.6-14.7)	0.0%
Thailand	Bangkok	1999-2008	14.9 (8.8-23.3)	0.1%
Thailand	Chachoengsao	2004-2008	6.6 (1.1-14.7)	0.0%
Thailand	Chon Buri	1999-2008	10.1 (4.3-19.1)	0.2%
Thailand	Chiang Mai	1999-2008	4.2 (0.4-10.7)	0.0%
Thailand	Khon Kaen	2000-2008	7.0 (1.5-14.3)	0.5%
Thailand	Lampang	1999-2008	2.9 (0.5-6.5)	0.0%
Thailand	Nakhon Ratchasima	1999-2008	5.8 (0.8-14.1)	0.0%
Thailand	Nakhon Sawan	1999-2008	4.8 (0.5-11.7)	0.0%
Thailand	Nonthaburi	1999-2008	12.9 (5.4-23.0)	0.2%
Thailand	Pathum Thani	1999-2008	12.1 (3.3-26.2)	0.8%
Thailand	Ratchaburi	1999-2008	9.8 (2.1-21.5)	0.5%
Thailand	Rayong	1999-2008	11.0 (4.3-20.2)	0.4%

Thailand	Samutprakan	1999-2008	16.9 (5.0-33.0)	1.9%
Thailand	Samut Sakhon	1999-2008	36.3 (9.7-76.2)	37.2%
Thailand	Songkhla	1999-2008	6.0 (1.1-12.6)	0.2%
Thailand	Saraburi	1999-2008	7.8 (2.3-16.1)	0.0%
Thailand	Surat Thani	1999-2008	5.9 (0.8-14.0)	0.0%
Taiwan	Kaohsiung	1994-2014	23.3 (9.9-46.9)	8.8%
Taiwan	Taipei	1994-2014	12.6 (4.3-28.6)	2.0%
Taiwan	Taichung	1994-2014	10.3 (4.2-20.7)	0.1%
Australia	Brisbane	2000-2009	5.3 (1.6-14.7)	0.1%
Australia	Melbourne	2000-2009	5.0 (0.0-22.9)	1.5%

[(a)] Current limit of daily concentration of SO^2 in the World Health Organization (WHO) guidelines.

Table S2. Average mean concentration of sulfur dioxide (SO_2, in μg/m^3) and percentage of days above 40 μg/m^3 across cities by decade within each country (separating the USA in nine regions). The analysis includes data from 399 cities within the study period 1980-2018.

	Average SO_2 concentration (μg/m^3)				Percentage of days above 40 μg/m^3 [(a)]			
	1980-89	1990-99	2000-09	2010-18	1980-89	1990-99	2000-09	2010-18
Canada	-	-	6.9	3.2	-	-	1.5%	0.5%
USA-Central	27.2	19.6	13.8	-	20.0%	8.9%	3.8%	-
USA-NECentral	14.7	9.6	6.2	-	5.4%	1.5%	0.9%	-
USA-NorthEast	27.9	19.8	13.8	-	20.8%	9.7%	3.4%	-
USA-NorthWest	14.4	15.6	6.0	-	2.9%	2.3%	0.0%	-
USA-NWCentral	4.7	4.0	1.4	-	0.0%	0.8%	0.1%	-
USA-South	13.3	9.3	5.9	-	7.7%	2.2%	0.6%	-
USA-SouthEast	12.5	10.4	7.1	-	4.8%	2.6%	0.6%	-
USA-SouthWest	11.7	9.6	4.9	-	4.3%	1.8%	0.0%	-
USA-West	5.9	4.7	4.3	-	0.2%	0.1%	0.0%	-
Puerto Rico	-	-	3.6	4.7	-	-	0.0%	0.8%
Brazil	-	16.4	12.0	7.3	-	2.0%	0.3%	0.1%
Colombia	-	31.4	24.1	7.7	-	20.4%	6.2%	0.0%
Ecuador	-	-	-	16.7	-	-	-	0.2%
Peru	-	-	-	12.8	-	-	-	0.1%
Estonia	-	-	3.0	2.3	-	-	0.8%	0.5%
Finland	-	10.7	8.5	8.3	-	1.0%	0.9%	1.0%
UK	-	15.0	7.2	3.8	-	6.0%	0.5%	0.0%
Czech Republic	-	28.4	6.3	-	-	22.8%	0.0%	-
Germany	-	12.3	5.2	3.0	-	4.8%	0.1%	0.0%
Romania	-	-	10.4	7.9	-	-	1.1%	0.3%
Switzerland	-	10.0	5.4	2.6	-	1.0%	0.0%	0.0%
Portugal	-	10.4	3.5	2.8	-	3.5%	0.0%	0.3%
Spain	-	-	6.1	4.8	-	-	0.2%	0.0%
Iran	-	-	138.3	47.8	-	-	82.9%	55.0%
China	-	17.3	49.8	47.3	-	4.7%	45.8%	44.9%
Japan	8.4	5.9	3.8	6.0	0.0%	0.0%	0.0%	0.4%
South Korea	-	25.3	15.7	13.6	-	11.9%	0.8%	0.2%
Thailand	-	12.1	10.0	-	-	3.8%	2.2%	-
Taiwan	-	21.6	13.9	11.0	-	12.1%	0.4%	0.0%
Australia	-	-	5.1	-	-	-	0.8%	-
All MCC countries	19.0	14.2	10.5	6.3	11.7%	5.4%	3.5%	1.3%

[(a)] Current limit of daily concentration of SO^2 in the World Health Organization (WHO) guidelines.

Table S3. Country-specific and pooled risk ratios (RR) for mortality corresponding to an increase in 10 μg/m^3 in sulfur dioxide (SO_2) over lag 0-3 days [(1)]. The estimates correspond to those reported graphically in Figure 2. The analysis includes data from 399 cities within the study period 1980-2018.

Country	**RR (95% CI)** [(1)]
Canada	1.0035 (0.9983 to 1.0087)
USA-Central	1.0031 (1.0001 to 1.0061)
USA-NECentral	1.0039 (1.0000 to 1.0078)
USA-NorthEast	1.0033 (1.0006 to 1.0061)
USA-NorthWest	1.0009 (0.9948 to 1.0070)
USA-NWCentral	1.0042 (0.9942 to 1.0143)
USA-South	1.0051 (1.0010 to 1.0092)
USA-SouthEast	1.0007 (0.9972 to 1.0042)
USA-SouthWest	1.0049 (0.9993 to 1.0106)
USA-West	1.0150 (1.0099 to 1.0200)
Puerto Rico	1.0011 (0.9910 to 1.0114)
Brazil	1.0234 (1.0168 to 1.0300)
Colombia	1.0004 (0.9933 to 1.0076)
Ecuador	1.0046 (0.9934 to 1.0159)
Peru	1.0065 (0.9965 to 1.0167)
Estonia	1.0029 (0.9921 to 1.0138)
Finland	0.9968 (0.9883 to 1.0054)
UK	0.9975 (0.9944 to 1.0006)
Czech Republic	0.9999 (0.9941 to 1.0058)
Germany	1.0027 (0.9992 to 1.0063)
Romania	1.0043 (0.9950 to 1.0136)
Switzerland	1.0080 (0.9976 to 1.0184)
Portugal	1.0067 (0.9989 to 1.0144)
Spain	1.0114 (1.0030 to 1.0199)
Iran	0.9997 (0.9971 to 1.0024)
China	1.0034 (1.0005 to 1.0063)
Japan	1.0016 (0.9966 to 1.0067)
South Korea	1.0097 (1.0042 to 1.0152)
Thailand	1.0101 (1.0032 to 1.0171)
Taiwan	0.9994 (0.9940 to 1.0048)
Australia	1.0039 (0.9960 to 1.0118)
Pooled	1.0045 (1.0019 to 1.0070)

[(1)] Estimates based on the main model assuming a linear exposure-response relationship and a moving average of lag 0-3 days.

Table S4. Number of cities included in the sensitivity analysis with bi-pollutant models including sulfur dioxide (SO_2, in $\mu g/m^3$) and each of the co-pollutant, namely particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2) and carbon monoxide (CO). The full data include 399 cities within the study period 1980-2018.

	PM_{10}	PM_{25}	O_3-8h	NO_2	CO
Canada	0	24	24	24	24
USA-Central	18	17	29	21	26
USA-NECentral	4	6	12	8	9
USA-NorthEast	17	19	42	34	36
USA-NorthWest	3	1	4	2	4
USA-NWCentral	2	1	2	1	1
USA-South	3	10	15	13	14
USA-SouthEast	14	21	27	22	23
USA-SouthWest	5	5	9	8	7
USA-West	4	8	15	15	15
Puerto Rico	1	0	0	0	1
Brazil	1	0	0	1	0
Colombia	1	0	0	1	0
Ecuador	0	1	0	1	1
Peru	1	0	0	1	0
Estonia	4	3	4	4	0
Finland	1	1	0	1	1
UK	27	16	0	30	30
Czech Republic	1	0	1	1	0
Germany	11	6	12	12	12
Romania	3	7	0	8	7
Switzerland	4	4	4	4	3
Portugal	5	4	6	6	2
Spain	43	15	45	48	46
Iran	1	1	0	1	1
China	15	3	0	15	3
Japan	46	39	46	46	6
South Korea	7	0	7	7	7
Thailand	18	0	0	18	18
Taiwan	3	3	3	3	3
Australia	2	2	2	2	2
All MCC countries	265	217	309	358	302

Table S5. Excess mortality fraction (%) attributable to short-term exposure to sulfur dioxide (SO_2) below the World Health Organization (WHO) guideline limit of 40 µg/m^3 by country (separating the USA in nine regions) and decade[(a)]. The analysis includes data from 399 cities within the study period 1980-2018.

	1980-1989	1990-1999	2000-2009	2010-2018	Full period
Canada	-	-	0.24 (0.12 to 0.36)	0.10 (0.05 to 0.16)	0.19 (0.09 to 0.28)
USA-Central	0.73 (0.50 to 0.94)	0.54 (0.37 to 0.69)	0.39 (0.27 to 0.50)	-	0.54 (0.37 to 0.69)
USA-NECentral	0.68 (0.27 to 1.11)	0.49 (0.18 to 0.80)	0.34 (0.12 to 0.56)	-	0.49 (0.18 to 0.80)
USA-NorthEast	0.88 (0.66 to 1.10)	0.69 (0.51 to 0.86)	0.52 (0.38 to 0.66)	-	0.69 (0.51 to 0.86)
USA-NorthWest	0.15 (-0.50 to 0.77)	0.15 (-0.47 to 0.72)	0.06 (-0.32 to 0.39)	-	0.13 (-0.45 to 0.66)
USA-NWCentral	0.20 (-0.28 to 0.65)	0.20 (-0.28 to 0.65)	0.08 (-0.10 to 0.25)	-	0.15 (-0.21 to 0.49)
USA-South	0.57 (0.40 to 0.76)	0.47 (0.33 to 0.62)	0.33 (0.22 to 0.44)	-	0.45 (0.31 to 0.59)
USA-SouthEast	0.10 (-0.05 to 0.23)	0.07 (-0.02 to 0.16)	0.05 (-0.01 to 0.11)	-	0.07 (-0.02 to 0.15)
USA-SouthWest	0.51 (0.19 to 0.81)	0.46 (0.18 to 0.72)	0.26 (0.09 to 0.43)	-	0.39 (0.15 to 0.61)
USA-West	1.07 (0.86 to 1.29)	0.80 (0.66 to 0.94)	0.76 (0.64 to 0.88)	-	0.84 (0.70 to 0.99)
Puerto Rico	-	-	0.04 (-0.32 to 0.40)	0.05 (-0.39 to 0.47)	0.05 (-0.38 to 0.46)
Brazil	-	3.73 (2.67 to 4.67)	2.84 (2.04 to 3.57)	1.69 (1.21 to 2.12)	2.86 (2.05 to 3.59)
Colombia	-	0.13 (-1.94 to 2.16)	0.10 (-1.52 to 1.70)	0.03 (-0.49 to 0.56)	0.09 (-1.29 to 1.45)
Ecuador	-	-	-	0.76 (-1.06 to 2.54)	0.76 (-1.06 to 2.54)
Peru	-	-	-	0.83 (-0.41 to 2.17)	0.83 (-0.41 to 2.17)
Estonia	-	-	0.08 (-0.12 to 0.27)	0.04 (-0.05 to 0.13)	0.06 (-0.07 to 0.18)
Finland	-	-0.34 (-1.24 to 0.58)	-0.27 (-1.00 to 0.47)	-0.27 (-0.97 to 0.45)	-0.29 (-1.06 to 0.50)
UK	-	-0.41 (-0.70 to -0.13)	-0.14 (-0.20 to -0.08)	-0.06 (-0.10 to -0.02)	-0.22 (-0.36 to -0.09)
Czech Republic	-	-0.02 (-1.24 to 1.29)	-0.01 (-0.36 to 0.38)	-	-0.01 (-0.71 to 0.74)
Germany	-	0.33 (0.15 to 0.51)	0.15 (0.07 to 0.22)	0.09 (0.02 to 0.15)	0.22 (0.10 to 0.32)
Romania	-	-	0.53 (-0.26 to 1.28)	0.38 (-0.13 to 0.88)	0.42 (-0.16 to 0.97)
Switzerland	-	0.81 (0.15 to 1.56)	0.41 (0.14 to 0.71)	0.21 (0.07 to 0.36)	0.48 (0.13 to 0.85)
Portugal	-	0.41 (0.03 to 0.79)	0.27 (0.07 to 0.46)	0.11 (0.04 to 0.18)	0.23 (0.06 to 0.40)
Spain	-	-	0.82 (0.59 to 1.04)	0.60 (0.46 to 0.74)	0.73 (0.55 to 0.92)
Iran	-	-	-0.10 (-1.14 to 0.92)	-0.09 (-1.02 to 0.82)	-0.10 (-1.09 to 0.88)
China	-	0.56 (0.10 to 1.03)	1.03 (0.74 to 1.32)	1.09 (0.49 to 1.65)	0.99 (0.68 to 1.32)
Japan	0.17 (-0.18 to 0.51)	0.11 (-0.10 to 0.31)	0.06 (-0.04 to 0.16)	0.11 (0.02 to 0.19)	0.11 (-0.05 to 0.25)
South Korea	-	2.21 (1.63 to 2.79)	1.49 (1.09 to 1.88)	1.37 (1.00 to 1.73)	1.48 (1.08 to 1.87)
Thailand	-	1.18 (0.76 to 1.57)	1.05 (0.73 to 1.39)	-	1.06 (0.74 to 1.40)
Taiwan	-	-0.12 (-0.82 to 0.50)	-0.08 (-0.54 to 0.35)	-0.06 (-0.42 to 0.27)	-0.09 (-0.58 to 0.36)
Australia	-	-	0.19 (-0.10 to 0.48)	-	0.19 (-0.10 to 0.48)
All MCC countries	0.65 (0.54 to 0.75)	0.44 (0.37 to 0.50)	0.48 (0.42 to 0.54)	0.35 (0.27 to 0.43)	0.47 (0.41 to 0.52)

[(a)] Estimates based on the main model assuming a linear exposure-response relationship and a moving average of lag 0-3 days.

Supplementary Figures

Figure S1. Country-specific exposure-response association between short-term exposure to sulfur dioxide (SO_2, in µg/m^3) and mortality (as best linear unbiased predictions) estimated from models using a linear term (red) and a quintic polynomial (blue). See the main text for the model definitions. The estimated relationships are shown within a range 0-100 µg/m^3, with 95% confidence intervals. The analysis includes data from 399 cities within the study period 1980-2018.