Supplemental Material: Chapter 6 (Cardiovascular Effects) Integrated Science Assessment for Particulate Matter

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Supplemental Tables for Chapter 6 (Cardiovascular Effects)

Table S6-1. Corresponding risk estimates for studies presented in Figure 6-2

Study	Location	Mean (ug/m^3)	Averaging Time	Lag (days)	Notes	Relative Risk (95% CI)
			IHD			
Dominici et al. (2006)	204 U.S. Urban counties	13.4	24-h avg	2	Ages 65+	1.00 (1, 1.01)
Barnett et al. (2006)	4 Australian cities	8.1-9.7	24-h avg	0-1	Ages 65+	1.04 (1.02, 1.06)
Host et al. (2007)	6 French cities	13.8-18.6	24-h avg	0-1	Ages 65+	1.05 (1.02, 1.07)
†Bell et al. (2015)	213 U.S. counties	12.3	24-h avg	0	Ages 65+	1.00 (1.00, 1.01)
†Kloog et al. (2014)	7 Mid-Atlantic states and Washington, D.C.	11.9	2-d avg	0-1	Ages 65+	1.01 (1.01, 1.01)
†Haley et al. (2009)	8 New York cities	5.8	24-h avg	1	Ages 65+	1.00 (1.00, 1.01)
†Hsu et al. (2017)	4 NY Regions		24-h avg	0	NYC, Long Island, and Hudson	1.01 (1.00, 1.02)
					Adirondack & North	1.01 (0.98, 1.03)
					Mohawk Valley & Birmingham	1.00 (0.97, 1.02)
					Central & Western New York	1.00, (0.99, 1.01)
†Talbott et al. (2014)	7 U.S. states	6.5-12.8	24-h avg	0-2	Florida	0.99 (0.98, 1.01)
					Massachusetts	1.00 (0.99, 1.02)
					New Jersey	1.02 (1.01, 1.03)
					New Hampshire	0.99 (0.94, 1.03)
					New Mexico	0.97 (0.90, 1.04)
					New York	1.01 (1.00, 1.02)

					Washington	1.00 (0.98, 1.02)
†Ostro et al. (2016)	8 CA counties	16.5	24-h avg.	0		1.01 (1.00, 1.03)
†Milojevic et al. (2014)	15 Conurbations in England and Wales	10	24-h avg	0−4		0.99 (0.98, 1.00)
†Sarnat et al. (2015)	St. Louis, Missouri-Illinois Metropolitan	18	24-h avg	0−2		1.01 (0.98, 1.03)
			MI			
Zanobetti and Schwartz (2006)	Boston, Massachusetts	11.1	24-h avg	0		1.01 (1.00, 1.01)
†Milojevic et al. (2014)	15 Conurbations in England and Wales	10	24-h avg	0−4		1.00 (0.99, 1.01)
					STEMI	0.98 (0.97, 1.00)
					NSTEMI	1.01 (0.99, 1.02)
†Bell et al. (2015)	213 U.S. counties	12.3	24-h avg	0	Ages 65+	1.00 (1.00, 1.01)
†Zanobetti et al. (2009)	26 U.S. cities	15.3	2-d avg	0-1	Ages 65+	1.02 (1.01, 1.03)
			Angina/MI			
†Stieb et al. (2009)	6 Canadian cities	6.7-9.8	24-h avg	0		1.02 (0.98, 1.07)
			Angina			
†Szyszkowicz (2009)	6 Canadian cities	8.3	24-h avg	0		1.02 (1.01, 1.04)
			MI			
†Weichenthal et al. (2016)	16 cities in Ontario, Canada	6.9	24-h avg	0-2		1.03 (1.00, 1.08)
†Talbott et al. (2014)	7 U.S. states	6.5-12.8	24-h avg	0-2	Florida	1.00 (0.99, 1.02)
					Massachusetts	0.99 (0.98, 1.01)
					New Jersey	1.01 (0.99, 1.02)
					New Hampshire	1.01 (0.95, 1.07)

					New Mexico	0.99 (0.90 1.08)
					New York	1.00 (0.99, 1.01)
					Washington	1.01 (0.99, 1.04)
†Ostro et al. (2016)	8 California counties	16.5	Overall avg	2		1.01 (0.98,1.04)
†Rich et al. (2010)	New Jersey	7.6-12.3	24-h avg	0-23		1.02 (0.98, 1.07)
					Transmural MI	1.09 (1.01, 1.18)
					Non-Transmural MI	0.99 (0.94, 1.05)
†Pope et al. (2015)	3 Utah cities	9.9 - 10.6	24-h avg	0	STEMI	1.08 (1.01, 1.16)
					NSTEMI	1.00 (0.97, 1.03)
					Unstable Angina	1.04 (1.00, 1.09)
†Gardner et al. (2014)	Rochester, NY	8	1-h avg	0	STEMI	0.91 (0.69, 1.21)
					NSTEMI	1.03 (0.77, 1.37)

†Studies published since the 2009 PM Integrated Science Assessment.
IHD = ischemic heart disease; MI = myocardial infarction; STEMI = ST segment elevation MI; NSTEMI = non-ST segment elevation MI; avg = average; CI = confidence interval; NR = not reported.

Table S6-2. Study details and mean and upper percentile concentrations of $PM_{2.5}$ from included short-term cardiovascular hospital admission and emergency department visit studies

Study	Exposure Assessment	Outcome Assessment	Mean (SD) and Upper Percentile Concentrations ($\mu g/m^3$)	Copollutant Examination
Barnett et al. (2006) Four Australian cities (1998-2001)	Monitors in city averaged 3 monitors Sydney, 2 monitors Melbourne and Perth, 1 monitor Brisbane.	IHD, Heart Failure, CBVD, CVD, Cardiac Diseases Age ≥ 65 yr	24-h avg: 8.1 to 9.7 (NR) (across four cities) Max: 29.3 to 122.8 (across four cities)	No copollutant models examined Copollutant correlations NR.
Bell et al. (2008) 202 U.S. counties (1999-2010)	Monitors in county averaged	CVD Age ≥ 65 yr	NR	No copollutant models examined Copollutant correlations NR.
Burnett et al. (1999) Toronto, Canada (1980-1994)	1 monitor $PM_{2.5}$, PM_{10}, $PM_{10-2.5}$ values not available for full study period. Values estimated from single TSS monitor.	PVD	24-h avg: 18.0 (NR) 75^{th}: 22.0 Max: 90.0	No quantitative results presented. Authors state that there was a negative association.

Study	Exposure Assessment	Outcome Assessment	Mean (SD) and Upper Percentile Concentrations (µg/m^3)	Copollutant Examination
Dominici et al. (2006) 204 U.S. Urban counties (1999-2002)	Monitors in county averaged Number NR. Study population reside an average of 5.9 miles from monitor. Median pairwise correlation between same-county monitors 0.91.	IHD, Heart Failure, Arrhythmia, PVD, CBVD Age ≥ 65 yr	24-h avg: 13.4 (IQR 3.9) 75th: 15.2	No copollutant models examined Copollutant correlations NR.
Host et al. (2007) Six French cities (2000-2003)	Monitors in city averaged 4 monitors Paris, 1 monitor Toulouse, 2 monitors other cities. Residents within 20 km. Between-monitor r > 0.60.	IHD Age ≥ 65 yr	24-h avg: 13.8 to 18.6 (NR) (across six cities) 95th: 25.0 to 33.0 (across six cities)	No copollutant models examined r = 0.28-0.73 $PM_{10-2.5}$ across cities.
Host et al. (2008) Six French cities (2000-2003)	Monitors in city averaged 4 monitors Paris, 1 Toulouse, 2 other cities. Residence within 20 km. Between-monitor r > 0.6	CVD, Cardiac Diseases	24-h avg: 13.8 to 18.6 (across six cities) 95th: 25.0 to 33.0 (across six cities)	No copollutant models examined r = 0.28-0.73 $PM_{10-2.5}$ across cities
Levy et al. (2001) Seattle, Washington (1988-1994)	Monitors in city averaged 3 monitors R^2 to $PM_{2.5}$ = 0.85.	OHCA Age 25-75 yr Married and in-person interview	24-h avg: 18.4 (NR) 75th: 23.0 Max: 96.0	No copollutant models examined. Copollutant correlations NR.
Rosenthal et al. (2008) Indianapolis, Indiana (2002-2006)	1 monitor 2002 data from separate monitor. R^2 = 0.87.	OHCA	24- avg Median: 13.9 75th: 19.5 90th: 25.8	No copollutant models examined. Copollutant correlations NR.
Sullivan et al. (2003) Seattle, Washington (1985-1994)	Monitors in city averaged 3 monitorsR^2 to $PM_{2.5}$ = 0.85.	OHCA	24-h avg: 0.71 (x 10^{-1} km^{-1} bsp) IQR: 13.8 (µg/m^3)	No copollutant models examined. Copollutant correlations NR.
Zanobetti and Schwartz (2006) Boston, Massachusetts (1995-1999)	1 monitor Data missing for 1998.	MI Age ≥ 65 yr	24-h avg Median: 11.1 (IQR 8.9) 75th: 16.1	No copollutant models examined r = 0.66 BC, 0.55 NO_2, 0.52 CO, 0.20 O_3, 0.74 PM non-traffic.
†Basagaña et al. (2015) Four cities in Spain and Italy (2003-2013)	1 monitor per city Madrid monitor urban, other 3 cities urban background	CVD	24-h avg: 20.7 to 27.6 (across four cities)	No copollutant models examined PM_{10} correlation NR. (PM_{10} and $PM_{2.5}$ monitors not available in same cities).
†Bell et al. (2014) Four counties in Massachusetts and Connecticut	1 monitor per county for 3 counties, one CT county used populated weighted average of 2 monitors	CVD Age ≥ 65 yr	24-h avg: 14.0 (9.4) Median: 11.7	No copollutant models examined Copollutant correlations NR.

Study	Exposure Assessment	Outcome Assessment	Mean (SD) and Upper Percentile Concentrations (µg/m³)	Copollutant Examination
(2000-2004)				
†Bell et al. (2015) 213 U.S. counties (1999-2010)	Monitors in county averaged	IHD, MI, Heart Failure, Heart Rhythm Disturbance, PVD, CBVD, CVD Age ≥ 65 yr	24-h avg: 12.3 (NR) Max: 20.2	No copollutant models examined Copollutant correlations NR.
†Bravo et al. (2017) 708 U.S. counties (2002-2006)	Fused-CMAQ Downscaler Model CMAQ combined with monitoring data, census tract estimates used to predict county level 24h PM2.5.	CVD Age ≥ 65 yr	Mean: 12.60 (NR)	No copollutant models examined Copollutant correlations NR.
†Brook and Kousha (2015) Calgary and Edmonton, Canada (Jan. 2010-Dec. 2011)	Average of monitors in 35 km of patient zip code centroid	Hypertension	24-h avg Calgary: Median: 10.1 Max: 138.4 Edmonton: Median: 8.1 Max: 156.3	No copollutant models examined. Copollutant correlations NR.
†Bunch et al. (2011) Wasatch Front, Utah 1994-2006	3 monitors	Atrial Fibrillation	24-h avg: 10.1-11.1 (across 3 monitors)	No copollutant models examined Copollutant correlations NR.
†Caussin et al. (2015) Paris, France (2003-2008)	Monitors in city averaged. 22 monitors in metro Paris	MI	24-h avg: 15.2 (IQR 9.6) 75th: 18.6	No copollutant models examined. r = 0.61 NO_2, 0.43 SO_2, 0.51 CO, -0.09 O_3, 0.95 PM_{10}
†Chang et al. (2015) Kaohsiung City, Taiwan (2006-2010)	Monitors in city averaged 6 monitors	IHD, Heart Failure, Arrhythmia, Stroke	24-h avg: 45.88 (NR) 75th: 61.88 Max: 144.37	$PM_{2.5}$ with SO_2, O_3, NO_2, and CO.. r (Pearson) = 0.80 NO_2, 0.25 SO_2, 0.81 CO, 0.42 O_3
†Chen et al. (2014) Edmonton, Canada (1998-2002)	Monitors in city averaged 3 monitors	Acute Ischemic Stroke Age ≥ 25 yr	1-h avg: 8.53 (8.66) 95th: 22.00	No copollutant models examined r = 0.43 NO_2, 0.15 SO_2, 0.48 CO, -0.15 O_3, 0.79 PM_{10}
†Chen et al. (2015)	See Chang et al. (2015) above.			$PM_{2.5}$ with SO_2, NO_2, CO, O_3. r (Pearson) = 0.80 NO_2, 0.25 SO_2, 0.81 CO, 0.42 O_3
†Chiu et al. (2013) Taipei, Taiwan (2006-2010)	Monitors in city averaged 6 monitors	Arrhythmia	24-h avg: 29.99 75th: 36.92 Max: 140.54	$PM_{2.5}$ with SO_2, NO_2, O_3, CO. r (Pearson) = 0.61 SO_2, 0.54 NO_2, 0.54 CO, 0.31 O_3

Study	Exposure Assessment	Outcome Assessment	Mean (SD) and Upper Percentile Concentrations (μg/m³)	Copollutant Examination
†Chiu and Yang (2013) Taipei, Taiwan (2006-2010)	Monitors in city averaged 6 monitors	Ischemic Stroke	24-h avg: 29.99 75th: 36.92 Max: 140.54	$PM_{2.5}$ with SO_2, NO_2, O_3, CO. *r* (Pearson) = 0.61 SO_2, 0.54 NO_2, 0.54 CO, 0.31 O_3
†Chiu et al. (2014) Taipei, Taiwan (2006-2010)	Monitors in city averaged 6 monitos	Hemorrhagic Stroke	24-h avg: 29.99 75th: 36.92 Max: 140.54	$PM_{2.5}$ with SO_2, NO_2, O_3, CO. *r* (Pearson) = 0.61 SO_2, 0.54 NO_2, 0.54 CO, 0.31 O_3
†Claeys et al. (2015) All 9 Belgium Provinces (2006-2009)	Monitors in country averaged. 73 monitors	MI	24-h avg: 20.1 (14.5) Max = 112	No copollutant models examined. *r* = 0.93 PM_{10}, -0.35 O_3
†Dales et al. (2010) Santiago, Chile (Apr. 1998-Aug. 2005)	Monitor values assigned to central and adjacent municipalities. 6 monitors	VTE, PE	24-h avg: 32.99 IQR: 20.02	No copollutant models examined. Copollutant correlations varied regionally: *r* = 0.73-0.92 NO_2, 0.72-0.83 SO_2, 0.4-0.83 CO, -0.32 to -0.14 O_3, 0.85-0.92 PM_{10}
†Dennekamp et al. (2010) Melbourne, Australia (2003-2006)	1 monitor	OHCA Age ≥ 35 yr	24-h avg: 6.35 (NR) IQR: 4.26 75th: 7.45	$PM_{2.5}$ with NO_2, O_3, CO (graphical only). *r* = 0.49 NO_2, 0.13 O_3, 0.55 CO
†Ensor et al. (2013) Houston, Texas (2004-2011)	Monitors in city averaged 12 monitors	OHCA Age ≥ 18 yr	1-h avg: 11.42 (5.98) 75th: 14.37 95th: 22.8 24-h avg: 11.42 (4.73) 75th: 13.71 95th: 20.96	No copollutant models examined. *r* (Pearson) = 0.24 NO_2, 0.05 SO_2, 0.34 CO, 0.01 O_3
†Franck et al. (2011) Leipzig, Germany)Feb. 2002-Jan. 2003)	Monitors in city averaged Number monitors NR. City approx. 200 km^2	Hypertension	24-h avg: 20.61 (12.89) Max: 84.06	No copollutant models examined. Association with UFP *r* = -0.06 UFP
†Gardner et al. (2014) Rochester, New York (2007-2010)	1 monitor 1,500m from interstate highway	MI	1-h avg: 8.0 (5.7) 75th: 10.2 Max: 43.0	No copollutant models examined Copollutant correlations NR.

Study	Exposure Assessment	Outcome Assessment	Mean (SD) and Upper Percentile Concentrations (µg/m³)	Copollutant Examination
†Haley et al. (2009) Eight New York cities (2001-2005)	Weighted averages across monitors in each city 39 monitors in total.	IHD, Heart Failure, Rhythm/Conduction, PVD, CBVD	24-h avg: 5.8 (IQR 5.9) 75th: 8.0 Max: 42.2	No copollutant models examined Copollutant correlations NR.
†Hsieh et al. (2013) Taipei, Taiwan (2006-2010)	Monitors in city averaged 6 monitors	Heart Failure	24-h avg: 29.99 (NR) 75th: 36.92 Max: 140.54	$PM_{2.5}$ with SO_2, NO_2, O_3, CO. *r* (Pearson) = 0.61 SO_2, 0.54 NO_2, 0.54 CO, 0.31 O_3
†Hsu et al. (2017) 4 New York Regions (1991-2006)	Adjusted CMAQ-simulated model (see Hogrefe et al. (2009)) 12x12 km grid resolution with patient residential address	IHD, Heart Failure, Arrhythmia, Hypertension, CBVD, CVD	Graphically reported only	No copollutant models examined Copollutant correlations NR.
†Ito et al. (2011) New York City (2000-2006)	Monitors in city averaged 3 monitors	CVD Age ≥ 40 yr	24-h avg: 14.44 (8.53)	No copollutant models examined *r* cold= 0.80 NO_2, 0.66 SO_2, 0.77 CO, warm = 0.63 NO_2, 0.57 SO_2, 0.52 CO
†Kim et al. (2012) Denver, Colorado (2003-2007)	1 monitor 90% of 5 county population within 25 km of monitor	IHD, Heart Failure, CBVD, CVD	24-h avg: 7.98 (5.08) Max: 59.41	No copollutant models examined. *r* = 0.30 O_3, 0.26 NO_2, 0.23 CO, 0.23 SO_2
†Kloog et al. (2012) Six New England states (2000-2008)	LUR modelling at 10 x 10 km spatial resolution using satellite-derived AOD measurements. Cross-validation R^2 = 0.85.	CVD Age ≥ 65 yr	24-h avg: 9.6 (4.9) 75th: 11.7 Max: 72.6	No copollutant models examined Copollutant correlations NR.
†Kloog et al. (2014) Seven Mid-Atlantic states and Washington, D.C. (2000-2006)	LUR modelling at 10 x 10 km spatial resolution using satellite-derived AOD measurements. Cross-validation R^2 = 0.81.	IHD, Stroke, CVD Age ≥ 65 yr	2-d avg: 11.92 (5.68) 75th: 14.65 Max: 95.85	No copollutant models examined Copollutant correlations NR.
†Kloog et al. (2015) Northeastern U.S. (13 states) (2000-2008)	LUR modelling at 10 x 10 km spatial resolution using satellite-derived AOD measurements. Cross-validation R^2 using monitors within 10 km: 0.82.	DVT, PE Age ≥ 65 yr	2-d mvg avg: 12.6 (6.8) 75th: 15.9 Max: 96.0	No copollutant models examined Copollutant correlations NR.
†Lall et al. (2011) New York City (2001-2002)	1 monitor	CVD	24-h avg: 17.26 (9.79)	No copollutant models examined Copollutant correlations NR.

Study	Exposure Assessment	Outcome Assessment	Mean (SD) and Upper Percentile Concentrations (μg/m^3)	Copollutant Examination
†Lisabeth et al. (2008) Nueces County, Texas (2001-2005)	1 monitor	Ischemic Stroke Transient Ischemic Attacks Age ≥ 45 yr	24-h avg Median: 7.0 IQR: 4.8-10.0	$PM_{2.5}$ with O_3. Copollutant correlations NR.
†Milojevic et al. (2014) 15 Conurbations in England and Wales (2003-2009)	Nearest monitor to patient's residence (50 km). Number NR.	IHD, MI, Heart Failure, Arrhythmia, Atrial Fibrillation, PE, CBVD, CVD	24-hr avg Median: 10.0 (IQR 8.0) 75th: 15.0	No copollutant models examined. r = 0.48 CO, 0.53 NO_2, -0.10 O_3, 0.86 PM_{10}, 0.41 SO_2
†O'Donnell et al. (2011) Eight cities in Ontario, Canada (2003-2008)	Monitors in city averaged 7 monitors Toronto, 6 monitors Hamilton, 1 monitor London, Ottawa, Kingston, North Bay, Thunder Bay, Sudbury. Excluded if > 50, 40, or 20 km from monitor in analyses.	Acute Ischemic Stroke	24-h avg: 6.9 (6.3) (across eight cities)	No copollutant models examined Copollutant correlations NR.
†Ostro et al. (2016) 8 California counties (2005-2009)	Nearest monitor Within 20 km of population-weighted centroid of zip code	IHD, MI, Heart Failure, Arrhythmia, CVD	Overall mean: 16.5 (IQR: 11.4) (across 8 counties)	No copollutant models examined Copollutant correlations NR.
†Peng et al. (2009) 119 U.S. counties (2000-2006)	Monitors in county averaged Most counties contain 2 monitors, 12 counties with 1. Within county r 0.85 (0.83-0.95)	CVD Age ≥ 65 yr	24-h avg: 11.79 Median: 9.4	No copollutant models examined Copollutant correlations NR.
†Pope et al. (2015) Utah's Wasatch Front (1993-2014)	Nearest monitor to patient's residence (zip code metro area) 3 monitors. Missing data imputed. 3 monitors used correlated with surrounding monitor sites (R^2 = 0.74-0.94)	Angina, MI	24-h avg Ogden: 9.9 (9.2) Max: 108 Salt Lake City: 10.6 (11.0) Max: 94 Provo/Orem: 10.0 (10.2) Max: 123	No copollutant models examined. Copollutant correlations NR.
†Qiu et al. (2013) Hong Kong, China (2000-2005)	1 monitor	IHD, CBVD, CVD	24-h avg: 39.4 75th: 50.1	$PM_{2.5}$ with $PM_{10-2.5}$. r = 0.68 $PM_{10-2.5}$, 0.79 NO_2, 0.46 SO_2, 0.47 O_3
†Rappold et al. (2012) 40 Rural North Carolina counties (2008)	Satellite-derived wildfire smoke emission estimates. HYSPLIT model, 13.5 km^2 grid of surface layer (lowest 100m estimates)	Heart Failure	24-h avg: NR Max. daily smoke related $PM_{2.5}$: 4 to 129	No copollutant models examined Copollutant correlations NR.

Study	Exposure Assessment	Outcome Assessment	Mean (SD) and Upper Percentile Concentrations (µg/m³)	Copollutant Examination
†Raza et al. (2014) Stockholm, Sweden (2000-2010)	Monitors in city averaged Number NR.	OHCA	24-h avg: 8.1 (NR) IQR: 4.81 Max: 161.7	No copollutant models examined. r = 0.24 NO_2, 0.17 $O_{3\text{-urban}}$, 0.25 $O_{3\text{-rural}}$, 0.19 $PM_{10\text{-}2.5}$
†Rich et al. (2010) New Jersey (2004-2006)	Nearest monitor to patient's residence (10 km) 7 monitors	MI	Median: 7.6 to 12.3 (across seven monitors) 75th: 2.8 to 18.8 (across seven monitors)	$PM_{2.5}$ with SO_2, O_3, NO_2, CO. r = 0.44 SO_2, 0.44 NO_2, 0.33 CO, 0.19 O_3
†Rodopoulou et al. (2014) Dona Ana County, New Mexico (2007-2010)	Monitors in county averaged 3 monitors	CVD Age ≥ 18 yr	24-h avg: 10.9 (NR) 75th: 13.0 Max: 55.6	No copollutant models examined r = -0.05 O_3, 0.41 PM_{10}
†Rodopoulou et al. (2015) Little Rock, Arkansas (2002-2012)	1 monitor 60% residents within 10km	Heart Failure & Hypertensive Heart Disease, Arrhythmia, Hypertension, CVD	24-h avg: 12.4 (5.9) 75th: 15.6	$PM_{2.5}$ with O_3 Copollutant correlations NR.
Rosenthal et al. (2008) Indianapolis, Indiana (2002-2006)	1 monitor 2002 data from separate monitor. R^2 = 0.87.	OHCA	24- avg Median: 13.9 75th: 19.5 90th: 25.8	No copollutant models examined Copollutant correlations NR.
†Samoli et al. (2016) London, UK (2011-2012)	1 monitor Urban background site	CVD	24-h avg: 12.2 (IQR: 8) 90th: 25.0	No copollutant models r = 0.28 O_3, 0.66 NO_2, 0.58 CO, 0.49 SO_2
†Sarnat et al. (2015) St. Louis, MO (8 counties MO, 8 counties IL) (2001-2003)	1 monitor 3 km from city center. Between monitor correlations for 12 monitors in study area r = 0.45 – 0.96, median 0.84	IHD, Heart Failure, Arrhythmia, CVD	24-h avg: 18.0 (8.3) 75th: 22.7 Max: 48.7	No copollutant models examined. r = 0.35 NO_2, 0.25 CO, 0.23 O_3, 0.08 SO_2
†Shih et al. (2011) 40 U.S. cities (1993-1998)	National scale spatial interpolation by kriging using U.S. EPA AQS monitors $PM_{2.5}$ data 1999-2004 only	VTE Women, ages 50-79 yr	24-h avg: 13.5 (7.7)	No copollutant models examined Copollutant correlations NR.
†Silverman et al. (2010) New York, New York	Monitors in city averaged 33 monitors located within 32 km radius of NYC center	OHCA	24-h avg Median: 12 IQR: 10 75th: 18	No copollutant models examined.

Study	Exposure Assessment	Outcome Assessment	Mean (SD) and Upper Percentile Concentrations (µg/m^3)	Copollutant Examination
(2002-2006)			95th: 30	r warm = 0.77 NO_2, 0.66 SO_2, 0.67 CO, -0.43 O_3 r cold = 0.54 NO_2, 0.51 SO_2, 0.40 CO, 0.61 O_3
†Stafoggia et al. (2013) Eight European cities (2001-2010)	Monitors in city averaged Number NR.	CVD Age ≥ 15 yr	24-h avg: 17.2 to 34.4 (across eight cities)	$PM_{2.5}$ with $PM_{10-2.5}$, O_3, NO_2. r close to 0 Barcelona, Marseille, Rome, ≥ 0.5 other cities $PM_{10-2.5}$. > 0.6 NO_2
†Stieb et al. (2009) Six Canadian cities (1992-2003)	Monitors in city averaged. 1 monitor Halifax, Ottawa, Vancouver, 3 Edmonton, 7 Montreal, and Toronto	Angina/MI, Heart Failure, Arrhythmia	24-h avg: 6.7 to 9.8 75th: 8.5 to 11.3	No copollutant models examined. r = -0.05 to 0.62 O_3, 0.27 to 0.51 NO_2, 0.01 to 0.55 SO_2, 0.01 to 0.42 CO.
†Straney et al. (2014) Perth, Australia (2000-2010)	Nearest monitor to arrest location. 4 available $PM_{2.5}$ monitors.	OHCA Age ≥ 35 yr	1-h avg Median: 6.8 75th: 9.8 95th: 17.7	No copollutant models examined. Copollutant correlations NR.
†Szyszkowicz (2009) Six Canadian cities (1992-2003)	Monitors in city averaged Number NR.	Angina	24-h avg: 8.3 (5.6)	No copollutant models examined. Copollutant correlations NR.
†Szyszkowicz et al. (2012) Edmonton, Canada (1992-2002)	Average of 3 monitors Max distance apart 10 km Zemek et al. (2010)	Hypertension All ages	24-h avg: 8.5 (6.2) 75th: 10.9	No copollutant models examined. r = 0.76 PM_{10}, 0.39 NO_2, 0.32 CO, 0.21 SO_2, 0.05 O_3
†Talbott et al. (2014) Seven U.S. states (2001-2009)	Fuse-CMAQ CMAQ model combined with monitoring data, downscaled to Census Tract resolution.	IHD, MI, Heart Failure, Arrhythmia, PVD, CBVD, CVD	24-h avg: 6.46 to 12.83 (2.55 to 7.66) (across seven states) 75th: 7.64 to 16.55 (across seven states)	$PM_{2.5}$ results adjusted for O_3 and temperature. Non-adjusted results NR. Copollutant correlations NR.
†Villeneuve et al. (2012) Edmonton, Canada (2003-2009)	Monitors in city averaged 3 monitors	Stroke Hemorrhagic Stroke Ischemic Stroke Transient Ischemic Attacks Ages ≥ 20 yr	24-h avg: 8.1 (5.8) 75th: 10.2	$PM_{2.5}$ with SO_2, NO_2, CO, O_3.. Copollutant correlations NR.

Study	Exposure Assessment	Outcome Assessment	Mean (SD) and Upper Percentile Concentrations (μg/m^3)	Copollutant Examination
†Weichenthal et al. (2016) 16 cities in Ontario, Canada (2004-2011)	Nearest monitor to patient's population-weighted postal code centroid	MI All Ages	24-h avg: 6.91 (5.97) Max: 56.8	$PM_{2.5}$ with NO_2, O_3, or NO_2 + O_3 oxidative potential. r = 0.51 NO_2, -0.49 O_3.
†Wellenius et al. (2012) Boston, Massachusetts (1999-2008)	1 monitor Patients excluded if > 40 km, sensitivity analysis at > 20 km	Acute Ischemic Stroke	24-h avg: 10.2 (6.0) 75th: 12.5	No copollutant models examined. r = 0.46 NO_2, 0.35 CO, 0.24 O_3
†Wichmann et al. (2013) Copenhagen, Denmark (2000-2010)	1 monitor Restricted to cases ~5 km of monitor.	OHCA	24-h avg: 10.16 (5.31) 75th: 11.57	$PM_{2.5}$ with O_3. r (Spearman) = 0.37 NO_x, 0.40 NO_2, -0.11 O_3, 0.37 CO, 0.34 UFP, 0.10 $PM_{10-2.5}$
†Wing et al. (2015) Nueces County, Texas (2000-2012)	1 monitor 85% cases within 20 km, median distance 6.9 km	Ischemic Stroke Age ≥ 45 yr	24-h avg: 7.7 (NR) IQR: 5.7-10.6	$PM_{2.5}$ with O_3. Copollutant correlations NR.
†Yitshak Sade et al. (2015) Southern Israel (2005-2012)	Hybrid model at 1 x1 km spatial resolution using LUR and satellite-derived AOD. Out-of-sample cross-validation R^2 = 0.72	Ischemic Stroke Hemorrhagic Stroke	24-h avg Winter: 21.9 (9.9) Spring: 21.6 (8.4), Summer: 20.4 (4.1) Fall: 20.2 (6.2)	No copollutant models examined Copollutant correlations NR.
†Zanobetti et al. (2009) 26 U.S. cities (2000-2003)	Monitors in county averaged 1 to 4 monitors per county. Monitor data discarded if between-monitor correlation < 0.8	MI, Heart Failure, CVD Age ≥ 65 yr	2-d avg: 15.3 (8.2) (across 26 cities)	No copollutant models examined Copollutant correlations NR.

†Studies published since the 2009 PM Integrated Science Assessment. Studies from the 2009 PM ISA are listed first, followed by studies published since the 2009 PM ISA, which are then listed by alphabetical order, and then by year published.
NR= not reported, RR = relative risk, OR = odds ratio, HR = hazard ratio, IQR = interquartile range, max = maximum, %ile = percentile, SD = standard deviation, $PM_{2.5}$ = particulate matter with mean aerodynamic diamter 2.5 µm, $PM_{10-2.5}$ = particulate matter with mean aerodynamic diamter between 2.5 µm and 10 µm, PM_{10} = particulate matter with mean aerodynamic diamter 10 µm, CO = carbon monoxide, NO_2 = nitrogen dioxide, SO_2 = sulfur dioxide. IHD = Ischemic Heart Disease, MI = Myocardial Infarction, OHCA = Out of Hosptial Cardiac Arrest, CBVD = Cerebrovascular Disease, PVD = Peripheral Vascular Disease, VTE = Venous Thromboembolism, PE = Pulmonary Embolism, DVT = Deep Vein Thrombosis, CVD = Aggregated Cardiovascular Diseases.

Table S6-3. Corresponding risk estimates for studies presented in Figure 6-3

Study	Location	Averaging Time	Mean (ug/m^3)	Lag (days)	Notes	Relative Risk (95% CI)
			HF			

Study	Location	Averaging Time	Mean (ug/m^3)	Lag (days)	Notes	Relative Risk (95% CI)
Dominici et al. (2006)	204 U.S. counties	24-h avg	13.4	0	Ages 65+	1.01 (1.01, 1.02)
Barnett et al. (2006)	4 Australian cities	24-h avg	8.1-9.7	0-1	Ages 14-64	1.08 (1.00, 1.17)
					Ages 65+	1.10 (1.05, 1.15)
†Bell et al. (2015)	213 U.S. counties	24-h avg	12.3	0	Ages 65+	1.01 (1.01, 1.015)
†Zanobetti et al. (2009)	26 U.S. cities	2-d avg	15.3	0-1	Ages 65+	1.02 (1.01, 1.03)
†Talbott et al. (2014)	7 U.S. states	24-h avg	6.5-12.8	0-2	Florida	0.99 (0.98, 1.00)
					Massachusetts	1.02 (01.00, 1.03)
					New Jersey	1.01 (1.00, 1.02)
					New Hampshire	1.02 (1.00, 1.02)
					New Mexico	1.01 (0.97, 1.05)
					New York	1.03 (1.02, 1.03)
					Washington	0.99 (0.98, 1.00)
†Hsu et al. (2017)	4 NY regions	24-h avg	NR	0	NYC, Long Island	1.02 (1.01, 1.03)
					Adirondack & North	0.97 (0.92, 1.01)
					Mohawk Valley & Binghamton	1.00 (0.97, 1.04)
					Central & Western NY	1.00 (0.98, 1.04)
†Haley et al. (2009)	8 New York cities	24-h avg	5.8	0		1.02 (1.01, 1.02)
†Ostro et al. (2016)	8 CA counties	Overall avg	16.5	1		1.00 (0.99, 1.01)
†Stieb et al. (2009)	6 Canadian cities	24-h avg	8.2	1		1.08 (1.00, 1.17)
†Milojevic et al. (2014)	15 conurbations in England and Wales	24-h avg	10 (Med.)	0-4		1.01 (0.99, 1.02)

Study	Location	Averaging Time	Mean (ug/m^3)	Lag (days)	Notes	Relative Risk (95% CI)
			HF & HHD			
†Rodopoulou et al. (2015)	Little Rock, AR	24-h avg	12.4	1		0.99 (0.93, 1.05)
			HF			
†Sarnat et al. (2015)	St. Louis, MO	24-h avg	18.0	0-2		1.01 (0.98, 1.05)

†Studies published since the 2009 PM Integrated Science Assessment
HF = heart failure, HHD = hypertensive heart disease, NR = not reported

Table S6-4. Corresponding risk estimates for studies presented in Figure 6-4

Study	Location	Outcome	Notes	Mean (µg/m^3)	Lag (days)	% Increase (95% CI)
Dominici et al. (2006)	204 U.S. counties	Arrhythmia	Age 65+	13.4	0	1.01 (1.00, 1.01)
†Bell et al. (2015)	213 U.S. counties	Arrhythmia	Age 65+	12.3	0	1.01 (1.00, 1.01)
†Talbott et al. (2014)	7 U.S. states	Arrhythmia	Massachusetts	6.5-12.8	0	1.02 (1.00, 1.03)
			New Jersey			1.01 (1.00, 1.02)
			New York			1.01 (1.00, 1.01)
†Hsu et al. (2017)	4 NY regions	Arrhythmia	NYC, Long Island & Hudson	NR	0	1.02 (1.01, 1.02)
			Central & Western NY			1.00 (0.97, 1.02)
†Milojevic et al. (2014)	15 conurbations in England and Wales	Arrhythmia		10 (Med.)	0-4	0.99 (0.97, 1.00)
		Atrial fibrillation				0.98 (0.97, 1.00)
†Stieb et al. (2009)	6 Canadian cities	Arrhythmia		6.7-9.8	0	0.99 (0.96, 1.02)
†Haley et al. (2009)	8 New York cities	Arrhythmia		5.8	0	0.99 (0.99, 1.01)
†Ostro et al. (2016)	8 CA counties	Arrhythmia		16.5	0	1.01 (0.99, 1.02)
†Sarnat et al. (2015)	St. Louis, MO	Arrhythmia		18.0	0-2	1.00 (0.97, 1.04)
†Rodopoulou et al. (2015)	Little Rock, AR	Arrhythmia	All	12.4	1	0.99 (0.93, 1.06)
			Cold Season			0.97 (0.88, 1.06)
			Warm Season			1.02 (0.94, 1.11)

†Studies published since the 2009 PM Integrated Science Assessment.
avg = average; CI = confidence interval; NR = not reported.

Table S6-5. Corresponding risk estimates for studies presented in Figure 6-5

Study	Outcome	Location	Notes	Mean (µg/m^3)	Lag (days)	Odds Ratio (95% CI)
Dominici et al. (2006)	CBVD	204 U.S. counties	Age 65+	13.4	0	1.01 (1.00, 1.01)
†Bell et al. (2015)	CBVD	213 U.S. counties	Age 65+	12.3	0	1.01 (1.00, 1.01)
†Kloog et al. (2012)	Stroke	6 New England states	Ages 65+	9.6	0-1	1.00 (01.00, 1.01)
†Kloog et al. (2014)	Stroke	7 Mid-Atlantic states	Ages 65+	11.9	0-1	1.00 (1.00, 1.01)
†Haley et al. (2009)	CBVD	8 New York cities		5.8	0	1.00 (0.99, 1.01)
†Milojevic et al. (2014)	Stroke	15 Conurbations in England and Wales		10 (Med.)	0-4	0.99 (0.98, 1.00)
†Talbott et al. (2014)	CBVD	7 U.S. states	Massachusetts	6.5-12.8	0	1.00 (0.99, 1.01)
			New Hampshire			0.96 (0.92, 1.01)
			New York			1.01 (1.00, 1.02)
†Hsu et al. (2017)	CBVD	4 NY regions	NYC, Long Island & Hudson	NR	0	1.01 (1.00, 1.02)
			Central & Western NY			1.00 (0.99, 1.02)
†Villeneuve et al. (2012)	Stroke	Denver, CO	Age 20+	8.1	0	1.02 (0.97, 1.09)
	Hemorrhagic Stroke					1.02 (0.85, 1.20)
	Ischemic Stroke					1.05 (0.97, 1.16)
	Transient Ischemic Attacks					0.98 (0.90, 1.09)
†Wellenius et al. (2012)	Acute Ischemic Stroke	Boston, MA		10.2	0-24h	1.18 (1.05, 1.33)
†Lisabeth et al. (2008)	Ischemic Stroke and Transient Ischemic Attacks	Nueces County, TX	Age 45+	7.0	1	1.06 (1.00, 1.14)

Study	Outcome	Location	Notes	Mean (µg/m^3)	Lag (days)	Odds Ratio (95% CI)
†Wing et al. (2015)	Ischemic Stroke	Nueces County, TX	Age 45+	7.7	0	1.11 (0.96, 1.28)
†O'Donnell et al. (2011)	Acute Ischemic Stroke	8 cities in Ontario		6.9	0-47h	0.99 (0.94, 1.05)
			Subjects < 20km from monitor			0.98 (0.93, 1.04)

†Studies published since the 2009 PM Integrated Science Assessment.
CBVD = cerebrovascular disease, avg = average; CI = confidence interval; NR = not reported.

Table S6-6. Corresponding risk estimates for studies presented in Figure 6-6

Study	Location	Notes	Mean (μg/m^3)	Lag (days)	Relative Risk (95% CI)
		CVD			
Bell et al. (2008)	202 U.S. counties	Age 65+	NR	0	1.01 (1.01, 1.01)
Host et al. (2008)	6 French cities		13.8-18.8	0-1	1.01 (1.00, 1.02)
		Age 65+			1.02 (1.01, 1.03)
Barnett et al. (2006)	4 Australian cities		8.1-9.7	0-1	1.01 (1.00, 1.02)
		Age 65+			1.02 (1.01, 1.03)
†Kloog et al. (2012)	6 New England states	Age 65+	9.6	0-1	1.01 (1.01, 1.02)
†Kloog et al. (2014)	7 Mid-Atlantic states	Age 65+	11.9	0-1	1.01 (1.01, 1.01)
†Bravo et al. (2017)	708 US counties	Age 65+	12.6	0	1.01 (1.01, 1.01)
†Hsu et al. (2017)	4 NY regions	NYC, Long Island, & Hudson	NR	0	1.01 (1.01, 1.01)
		Adirondack & North			1.00 (0.98, 1.02)
		Mohawk Valley & Binghamton			1.00 (0.98, 1.03)
		Central & Western NY			1.00 (0.99, 1.00)
†Bell et al. (2015)	213 U.S. counties	Age 65+	12.3	0	1.01 (1.01, 1.01)
†Peng et al. (2009)	119 U.S. counties	Age 65+	11.8	0	1.01 (1.00, 1.01)
†Zanobetti et al. (2009)	26 U.S. cities	Age 65+	15.3	0-1	1.02 (1.01, 1.03)
†Bell et al. (2014)	4 counties, MA & CT	Age 65+	14	0	1.02 (1.00, 1.03)
†Ostro et al. (2016)	8 CA counties		16.5	0	1.00 (1.00, 1.01)
†Talbott et al. (2014)	7 U.S. states	Florida	6.5-12.8	0-2	1.00 (0.99, 1.00)
		Massachusetts			1.01 (1.00, 1.01)
		New Jersey			1.01 (1.01, 1.02)
		New Hampshire			0.99 (0.97, 1.01)

Study	Location	Notes	Mean (μg/m^3)	Lag (days)	Relative Risk (95% CI)
		New Mexico			1.01 (0.97, 1.05)
		New York			1.01 (1.01, 1.01)
		Washington			0.99 (0.98, 1.00)
†Stafoggia et al. (2013)	8 European cities	Age 15+	17.2-34.4	0-1	1.01 (1.00, 1.01)
†Basagaña et al. (2015)	4 cities, Spain & Italy		20.7-27.6	0	1.02 (1.01, 1.04)
†Milojevic et al. (2014)	15 conurbations in England and Wales		10 (med.)	0-4	-1.1 (-1.7, -0.5)
†Kim et al. (2012)	Denver, CO		8	0-1	1.01 (1.00, 1.04)
†Rodopoulou et al. (2014)	Little Rock, AR		12.4	1	1.00 (0.97, 1.01)
		Age 65+			0.98 (0.94, 1.02)
†Rodopoulou et al. (2015)	Dona Ana County, NM	ED visit	10.9	1	1.05 (0.97, 1.01)
		HA			0.99 (0.94, 1.04)
		ED visit (65+)			1.08 (0.97, 1.21)
		HA (65+)			0.98 (0.93, 1.05)
†Sarnat et al. (2015)	St. Louis, MO		18.0	0-2	0.99 (0.98, 1.01)

†Studies published since the 2009 PM Integrated Science Assessment.
CVD = cardiovascular disease, avg = average; CI = confidence interval; ED = emergency department; HA = hospital admissions; NR = not reported.

Table S6-7. Corresponding risk estimates for studies presented in Figure 6-7

Study	Location	Outcome	Lag (days)	% Increase (95% CI)
†Lee et al. (2015b)[a]	3 Southeast states, U.S.	CVD	0-1	2.32 (1.57, 3.07)
		CHF		3.64 (1.35, 5.99)
		MI		1.12
		Stroke		0.55
†Dai et al. (2014)	75 U.S. cities	CVD	0-1	1.18 (0.93, 1.44)
		MI		1.22 (0.62, 1.82)
		Stroke		1.76 (1.01, 2.52)

Study	Location	Outcome	Lag (days)	% Increase (95% CI)
†Samoli et al. (2013)	10 European Med cities	CVD	0-1	0.57 (0.07, 1.08)
†{Samoli, 2014, 2443450@@author-year}	10 European Med cities	Cardiac		0.59 (-0.11, 1.3)
		CHF		-2.43 (-6.23, 1.51)
		Cerebrovascular		0.32 (-0.64, 1.3)
		Acute Coronary Events		-0.29 (-1.5, 0.93)
		Arrythmias		1.72 (-0.57, 4.11)
†Pascal et al. (2014)	9 French cities	CVD	0-1	0.7 (-0.2, 1.6)
		Cardiac		0.6 (-0.5, 1.7)
		IHD		0.6 (-1.1, 2.3)
		Cerebrovascular		1.5 (-0.9, 4)
†Milojevic et al. (2014)	England and Wales	CVD	0-1	0.87 (-0.25, 2.05)
		CHF		-2.01 (-6.70, 2.85)
		MI		0.69 (-2.01, 3.40)
		Stroke		1.74 (-0.50, 4.01)
		IHD		1.31 (-0.44, 2.97)
†Shah et al. (2015)	Meta-analysis	Stroke	NR	1.20 (1.10, 1.20)
†Wang et al. (2014)	Meta-analysis	Stroke	NR	1.40 (0.90, 1.90)

†Studies published since the 2009 PM Integrated Science Assessment.
[a]Lee et al. (2015b) did not provide 95% confidence intervals for the MI and stroke results.
CHF = congestive heart failure; CVD = cardiovascular; MI = myocardial infarction; IHD = ischemic heart disease; avg = average; CI = confidence interval; NR = not reported.
% increases are standardized to a 10 μg/m^3 increase in 24-h average $PM_{2.5}$ concentrations.

Table S6-8. Corresponding risk estimates for studies presented in Figure 6-8

Study	Location	Lag (days)	Notes	Copollutant	Correlation	Odds Ratio (95% CI)
			CVD			

Study	Location	Lag (days)	Notes	Copollutant	Correlation	Odds Ratio (95% CI)
Jalaludin et al. (2006)	Sydney, Australia	0				1.03 (1.01, 1.04)
				O_3	0.57	1.03 (1.02, 1.04)
†Stafoggia et al. (2013)	8 European cities	0-1				1.01 (1.00, 1.01)
				O_3	NR	1.00 (1.00, 1.01)
†Hsu et al. (2017)	4 NY regions	0	NYC, Long Island			1.01 (1.01, 1.02)
				O_3	NR	1.01 (1.01 (1.02)
			Central NY			1.00 (0.99, 1.01)
				O_3	NR	1.00 (0.99, 1.01)
†Rodopoulou et al. (2015)	Little Rock, AR	1				0.99 (0.97, 1.01)
				O_3	NR	0.99 (0.98, 1.01)
			IHD			
Ito (2003)	Detroit, MI	--				1.02 (0.98, 1.05)
				O_3	NR	1.02 (0.97, 1.05)
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2				1.11 (1.10, 1.13)
				O_3	0.42	1.09 (1.08, 1.11)
†Weichenthal et al. (2016)	Ontario, Canada	0	Myocardial Infarction			1.03 (1.00, 1.06)
				O_3	-0.49	1.08 (1.00, 1.06)
†Rich et al. (2010)	New Jersey	0	Transmural Infarction			1.07 (0.97, 1.19)
				O_3	0.19	1.07 (0.97, 1.19)
†Chang et al. (2013)	Taipei, Taiwan	0-2	Myocardial Infarction			1.03 (1.01, 1.05)
				O_3	0.31	1.03 (1.01, 1.06)
			Heart Failure			
Burnett et al. (1999)	Toronto, Canada	0-3	Heart Disease			1.03 (0.99, 1.07)
				O_3	0.32	1.01 (0.93, 1.10)
Ito (2003)	Detroit, MI	--				1.04 (1.00, 1.07)
				O_3	NR	1.06 (1.01, 1.08)

Study	Location	Lag (days)	Notes	Copollutant	Correlation	Odds Ratio (95% CI)
†Rodopoulou et al. (2015)	Little Rock, AR	1				0.99 (0.93, 1.05)
				O_3	NR	1.00 (0.93, 1.06)
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2	Cool Season			1.11 (1.08, 1.14)
				O_3	0.42	1.1 (1.06, 1.12)
†Hsieh et al. (2013)	Taipei, Taiwan	0-2	Warm Season			1.07 (1.05, 1.09)
				O_3	0.31	1.06 (1.04, 1.09)
			Arrhythmia			
†Rodopoulou et al. (2015)	Little Rock, AR	1				0.99 (0.93, 1.06)
				O_3	NR	0.98 (0.92, 1.04)
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2	Cool Season			1.12 (1.08, 1.16)
				O_3	0.42	1.10 (1.06, 1.14)
†Chiu and Yang (2013)	Taipei, Taiwan	0-2	Warm Season			1.06 (1.03, 1.08)
				O_3	0.31	1.06 (1.03, 1.09)
			OHCA			
†Dennekamp et al. (2010)	Melbourne, Australia	0-1				1.09 (1.03, 1.14)
				O_3	0.13	1.09 (0.95, 1.21)
†Wichmann et al. (2013)	Copenhagen, Denmark	0-1				0.97 (0.88, 1.07)
				O_3	-0.11	0.97 (0.88, 1.07)
†Rosenthal et al. (2013)	Helsinki, Finland	0-3				1.15 (0.91, 1.43)
				O_3	<0.06	0.74
			CBVD			
†Rodopoulou et al. (2015)	Little Rock, AR	1				0.97 (0.85, 1.09)
				O_3	NR	1.01 (0.89, 1.15)
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2	Stroke			1.11 (1.10, 1.13)
				O_3	0.42	1.10 (1.08, 1.11)

Study	Location	Lag (days)	Notes	Copollutant	Correlation	Odds Ratio (95% CI)
†Lisabeth et al. (2008)	Nueces County, TX	1	TIA			1.06 (1, 1.14)
				O_3	NR	1.06 (0.98, 1.12)
†Chiu and Yang (2013)	Taipei, Taiwan	0-2	Ischemic Stroke			1.06 (1.05, 1.08)
				O_3	0.31	1.06 (1.04, 1.078)
†Chiu et al. (2014)	Taipei, Taiwan	0-2	Hemorrhagic Stroke			1.07 (1.04, 1.10)
				O_3	0.31	1.07 (1.034, 1.11)
			CVD Mortality			
†Samoli et al. (2013)	Multicity, Europe	0-5				1.01 (1.00, 1.02)
				O_3	<0.4	1.01 (1.00, 1.02)
†Lee et al. (2015a)	Multicity, Asia	0-1				1.01 (1.00, 1.01)
				O_3	NR	1.01 (1.01, 1.02)

†Studies published since the 2009 PM Integrated Science Assessment.
TIA = transient ischemic attack; CVD = cardiovascular; IHD = ischemic heart disease; OHCA = out-of-hospital cardiac arrest; CBVD = cerebrovascular disease; NR = not reported; O_3 = ozone.
Associations are presented per 10 µg/m^3 increase in pollutant concentration.

Table S6-9. Corresponding risk estimates for studies presented in Figure 6-9

Study	Location	Lag (days)	Notes	Copollutant	Correlation	Odds Ratio (95% CI)
			CVD			
Moolgavkar (2003)	Los Angeles, CA	0				1.01 (1.00, 1.01)
				NO_2	0.73	1.01 (1.00, 1.02)
Jalaludin et al. (2006)	Sydney, Australia	0				1.03 (1.01, 1.04)
				NO_2	0.45	1.02 (1.00, 1.04)
†Stafoggia et al. (2013)	8 European cities	0-1				1.01 (1.00, 1.01)
				NO_2	>0.6	1.00 (1.00, 1.01)
			IHD			
Ito (2003)	Detroit, MI					1.02 (0.98, 1.05)
				NO_2	NR	1.03 (0.98, 1.06)
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2				1.11 (1.10, 1.13)
				NO_2	0.8	1.05 (1.03, 1.08)
†Weichenthal et al. (2016)	Ontario, Canada	0	Myocardial Infarction			1.03 (1.00, 1.06)
				NO_2	0.51	1.02 (0.99, 1.04)
†Rich et al. (2010)	New Jersey	0	Transmural Infarction			1.09 (1.00, 1.19)
				NO_2	0.44	1.07 (0.96, 1.20)
†Chang et al. (2013)	Taipei, Taiwan	0-2	Myocardial Infarction			1.03 (1.01, 1.05)
				NO_2	0.54	0.99 (0.97, 1.02)
			Heart Failure			
Burnett et al. (1999)	Toronto, Canada	0-3	Heart Disease			1.03 (0.99, 1.07)
				NO_2	0.45	1.02 (0.95, 1.09)
Ito (2003)	Detroit, MI					1.04 (1.00, 1.07)
				NO_2	NR	1.04 (1.00, 1.07)
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2	Cool Season			1.11 (1.08, 1.14)
				NO_2	0.8	1.06 (1.03, 1.10)

Study	Location	Lag (days)	Notes	Copollutant	Correlation	Odds Ratio (95% CI)
†Hsieh et al. (2013)	Taipei, Taiwan	0-2	Warm Season			1.07 (1.05, 1.09)
				NO_2	0.54	1.01 (0.98, 1.05)
Arrhythmia						
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2	Cool Season			1.12 (1.08, 1.16)
				NO_2	0.8	1.05 (1.00, 1.09)
†Chiu and Yang (2013)	Taipei, Taiwan	0-2	Warm Season			1.06 (1.03, 1.08)
				NO_2	0.54	1.00 (0.97, 1.03)
OHCA						
†Dennekamp et al. (2010)	Melbourne, Australia	0-1				1.09 (1.03, 1.15)
				NO_2	0.49	1.00 (0.86, 1.19)
†Rosenthal et al. (2013)	Helsinki, Finland	0-3				1.15 (0.91, 1.43)
				NO_2	<0.6	1.13
CBVD						
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2	Stroke			1.11 (1.10, 1.13)
				NO_2	0.8	1.06 (1.04, 1.08)
†Chiu and Yang (2013)	Taipei, Taiwan	0-2	Ischemic Stroke			1.06 (1.05, 1.08)
				NO_2	0.54	1.00 (0.98, 1.02)
†Chiu et al. (2014)	Taipei, Taiwan	0-2	Hemorrhagic Stroke			1.07 (1.04, 1.10)
				NO_2	0.54	1.03 (0.99, 1.07)
CVD Mortality						
†Samoli et al. (2013)	Multicity, Europe	0-5				1.01 (1.00, 1.02)
				NO_2	0.3-0.8	1.01 (1.00, 1.02)
†Lee et al. (2015a)	Multicity, Asia	0-1				1.01 (1.00, 1.01)
				NO_2	NR	1.01 (1.00, 1.09)

†Studies published since the 2009 PM Integrated Science Assessment.
CVD = cardiovascular; IHD = ischemic heart disease; OHCA = out-of-hospital cardiac arrest; CBVD = cerebrovascular disease; avg = average; CI = confidence interval; NO_2 = nitrogen dioxide; NR = not reported.
Associations are presented per 10 µg/m^3 increase in pollutant concentration.

Table S6-10. Corresponding risk estimates for studies presented in Figure 6-10

Study	Location	Lag (days)	Notes	Copollutant	Correlation	Odds Ratio (95% CI)
CVD						
Moolgavkar (2003)	Los Angeles, CA	0				1.01 (1.00, 1.01)
				SO_2	0.42	1.01 (0.99, 1.03)
Jalaludin et al. (2006)	Sydney, Australia	0				1.03 (1.01, 1.04)
				SO_2	0.27	1.02 (1.01, 1.04)
IHD						
Ito (2003)	Detroit, MI					1.02 (0.98, 1.05)
				SO_2	NR	1.02 (0.98, 1.05)
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2	Cool Season			1.11 (1.10, 1.13)
				SO_2	0.25	1.13 (1.12, 1.16)
†Rich et al. (2010)	New Jersey	0	Transmural Infarction			1.07 (0.98, 1.17)
				SO_2	0.44	1.09 (0.98, 1.22)
†Chang et al. (2013)	Taipei, Taiwan	0-2	Myocardial Infarction; Cool Season			1.03 (1.01, 1.05)
				SO_2	0.61	1.09 (1.06, 1.12)
HF						
Burnett et al. (1999)	Toronto, Canada	0-3	Heart Disease			1.03 (0.99, 1.07)
				SO_2	0.49	1.02 (0.96, 1.08)
Ito (2003)	Detroit, MI					1.04 (1.00, 1.07)
				SO_2	NR	1.04 (1.00, 1.07)
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2	Cool Season			1.11 (1.08, 1.14)
				SO_2	0.25	1.14 (1.10, 1.17)
†Hsieh et al. (2013)	Taipei, Taiwan	0-2	Warm Season			1.07 (1.05, 1.09)
				SO_2	0.61	1.08 (1.06, 1.11)
Arrhythmia						
†Chang et al. (2015)		0-2	Cool Season			1.12 (1.08, 1.16)

Study	Location	Lag (days)	Notes	Copollutant	Correlation	Odds Ratio (95% CI)
	Kaohsiung, Taiwan			SO_2	0.25	1.14 (1.10, 1.18)
†Chiu et al. (2014)	Taipei, Taiwan	0-2	Warm Season			1.06 (1.03, 1.08)
				SO_2	0.61	1.07 (1.03, 1.09)
			OHCA			
†Rosenthal et al. (2013)	Helsinki, Finland	0-3				1.15 (0.91, 1.43)
				SO_2	<0.6	1.07
			CBVD			
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2	Stroke; Cool Season			1.11 (1.10, 1.13)
				SO_2	0.25	1.14 (1.12, 1.16)
†Chiu and Yang (2013)	Tapei, Taiwan	0-2	Ischemic Stroke; Warm Season			1.06 (1.05, 1.08)
				SO_2	0.61	1.07 (1.05, 1.09)
†Chiu et al. (2014)	Taipei, Taiwan	0-2	Hemorrhagic Stroke; Warm Season			1.07 (1.04, 1.10)
				SO_2	0.61	1.07 (1.04 (1.11)
			CVD Mortality			
†Samoli et al. (2013)	Multicity, Europe	0-5				1.01 (1.00, 1.02)
				SO_2	<0.4	1.01 (0.99, 1.02)
†Lee et al. (2015a)	Multicity, Asia	0-1				1.01 (1.00, 1.01)
					NR	1.01 (1.00, 1.01)

†Studies published since the 2009 PM Integrated Science Assessment.
CVD = cardiovascular; IHD = ischemic heart disease; HF = heart failure; OHCA = out-of-hospital cardiac arrest; CBVD = cerebrovascular disease; avg = average; CI = confidence interval; NR = not reported; SO_2 = sulfur dioxide.
Associations are presented per 10 µg/m^3 increase in pollutant concentration.

Table S6-11. Corresponding risk estimates for studies presented in Figure 6-11

Study	Location	Lag (days)	Notes	Copollutant	Correlation	Odds Ratio (95% CI)
			CVD			
Moolgavkar (2003)	Los Angeles, CA	0				1.01 (1.00, 1.01)
				CO	0.58	1.01 (1.00, 1.02)
Jalaludin et al. (2006)	Sydney, Australia	0				1.03 (1.01, 1.04)
				CO	0.35	1.01 (0.99, 1.03)
			IHD			
Ito (2003)	Detroit, MI					1.02 (0.98, 1.05)
				CO	NR	1.02 (0.97, 1.05)
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2				1.11 (1.10, 1.13)
				CO	0.81	1.05 (1.03, 1.08)
†Rich et al. (2010)	New Jersey	0	Transmural Infarction			1.07 (0.98, 1.18)
				CO	0.33	1.09 (0.98, 1.20)
†Chang et al. (2013)	Taipei, Taiwan	0-2	Myocardial Infarction			1.03 (1.01, 1.05)
				CO	0.54	1.02 (0.99, 1.05)
			HF			
Burnett et al. (1999)	Toronto, Canada	0-3	Heart Disease			1.03 (0.99, 1.07)
				CO	0.42	1.03 (0.98, 1.07)
Ito (2003)	Detroit, MI					1.04 (1.00, 1.07)
				CO	NR	1.04 (1.00, 1.07)
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2	Cool Season			1.11 (1.8, 1.14)
				CO	0.81	1.06 (1.02, 1.11)
†Hsieh et al. (2013)	Taipei, Taiwan	0-2	Warm Season			1.07 (1.05, 1.09)
				CO	0.54	1.01 (0.98, 1.03)
			Arrythmia			
		0-2	Cool Season			1.12 (1.08, 1.16)

Study	Location	Lag (days)	Notes	Copollutant	Correlation	Odds Ratio (95% CI)
†Chang et al. (2015)	Kaohsiung, Taiwan			CO	0.81	1.04 (0.99, 1.10)
†Chiu and Yang (2013)	Taipe, Taiwan	0-2	Warm Season			1.06 (1.03, 1.08)
				CO	0.54	0.99 (0.97, 1.03)
OHCA						
†Dennekamp et al. (2010)	Melbourne, Australia	0-1				1.09 (1.03, 1.15)
				CO	0.55	1.02 (0.92, 1.11)
†Rosenthal et al. (2013)	Helsinki, Finland	0-3				1.15 (0.91, 1.43)
				CO	<0.6	0.90
CBVD						
†Chang et al. (2015)	Kaohsiung, Taiwan	0-2	Stroke			1.15 (0.91, 1.43)
				CO	0.81	0.90
†Chiu and Yang (2013)	Taipe, Taiwan	0-2	Ischemic Stroke			1.06 (1.05, 1.08)
				CO	0.54	1 (0.98, 1.02)
†Chiu et al. (2014)	Taipei, Taiwan	0-2	Hemorrhagic Stroke			1.07 (1.04, 1.10)
				CO	0.54	1.02 (0.98, 1.05)

†Studies published since the 2009 PM Integrated Science Assessment.
CO = carbon monoxide; CVD = cardiovascular; IHD = ischemic heart disease; HF = heart failure; OHCA = out-of-hospital cardiac arrest; CBVD = cerebrovascular disease; avg = average; CI = confidence interval; NR = not reported.
Associations are presented per 10 µg/m^3 increase in pollutant concentration.

Table S6-12. Corresponding risk estimates for studies presented in Figure 6-12

Study	Location	Lag (days)	Copollutant	Correlation	Odds Ratio (95% CI)
CVD					
Peng et al. (2008)	Multicity, US	0			1.00 (1.00, 1.01)
			$PM_{10-2.5}$	0.12	1.01 (1.00, 1.01)
†Stafoggia et al. (2013)	8 European cities	0-1			1.01 (1.00, 1.01)
			$PM_{10-2.5}$	<0.5	1.00 (1.00, 1.01)
†Qiu et al. (2013)	Hong Kong, China	0-1			1.01 (1.01, 1.01)
			$PM_{10-2.5}$	0.68	1.01 (1.01, 1.01)
IHD					
†Qiu et al. (2013)	Hong Kong, China	0-1			1.01 (1.01, 1.02)
			$PM_{10-2.5}$	0.68	1.01 (1.00, 1.02)
OHCA					
†Rosenthal et al. (2013)	Helsinki, Finland	0-3			1.15 (0.91, 1.43)
			$PM_{10-2.5}$	<0.6	0.86
CBVD					
†Qiu et al. (2013)	Hong Kong, China	0-1			1.00 (1.00, 1.01)
			$PM_{10-2.5}$	0.68	1.00 (1.00, 1.01)
CVD Mortality					
†Samoli et al. (2013)	Multicity, US	0-5			1.01 (1.00, 1.02)
			$PM_{10-2.5}$	<0.4	1.01 (1.00, 1.02)
†Janssen et al. (2013)	Netherlands	0-6			1.02 (1.01, 1.03)
			$PM_{10-2.5}$	0.29	1.02 (1.01, 1.03)
†Lee et al. (2015a)	Multicity, Asia	0-1			1.01 (1.00, 1.01)
			$PM_{10-2.5}$	NR	1.01 (1.00, 1.01)

†Studies published since the 2009 PM Integrated Science Assessment.
CVD = cardiovascular; IHD = ischemic heart disease; HF = heart failure; OHCA = out-of-hospital cardiac arrest; CBVD = cerebrovascular disease; avg = average; CI = confidence interval; NR = not reported; $PM_{10-2.5}$ = particulate matter with a nominal aerodynamic diameter less than or equal to 10 µm and greater than a nominal diameter of 2.5 µm.
Associations are presented per 10 µg/m^3 increase in pollutant concentration.

Table S6-13. Corresponding risk estimates for studies presented in Figure 6-17

Study	Cohort	Outcome	Years	Mean (µg/m^3)	Relative Risk (95% CI)
Miller et al. (2007)	WHI-Women (post-menopause), 36 Urban sites, U.S.	CHD	1994-1998	13.4	1.10 (1.02, 1.19)
†Hart et al. (2015)	NHS-Women, 48 states, U.S.	CHD	1989-2006	13.4	1.01 (0.96, 1.07)
†Puett et al. (2011)	CTS -Women, Los Angeles. California, U.S.	MI	1999-2005	15.6	0.99 (0.91, 1.08)
†Puett et al. (2011)	HPFU, Men, 13 states, U.S.	Nonfatal M	1988-2002	17.8	1.08 (0.90, 1.28)
†Madrigano et al. (2013)	Worcester Heart Attack, MA, U.S.	Confirmed MI	1995-2003	9.4	1.21 (1.00, 1.38)
†Hartiala et al. (2016)	Cardiac Patients, Ohio, U.S.	MI	1998-2010	15.5	1.91 (1.05, 3.48)
†Hoffmann et al. (2015)	HNR study, Ruhr region Germany	Coronary Event	2008-2009	18.4	1.00 (0.38, 2.67)
†Atkinson et al. (2013)	GP Database, U.K.	MI	2003-2007	12.9	0.95 (0.85, 1.05)
†Cesaroni et al. (2014)	ESCAPE- 11 Cohorts Europe	IHD	2008-2011	7.3-31	1.13 (0.98, 1.30)
†Tonne et al. (2015)	MINAP, London, U.K.	Recurrent MI/Death	2003-2010	14.6	1.21 (0.93, 1.55)
†Koton et al. (2013)	8 Treatment Centers, Israel	Recurrent MI	2003-2005	23.9	1.30 (0.95, 1.70)

†Studies published since the 2009 PM Integrated Science Assessment.
CI = confidence interval; CHD = Coronary Heart Disease; CTS = California Teachers Study; ESCAPE = European Study of Cohorts for Air Pollution; GP = General Practitioner; HNR = Heinz Nixdorf Recall study; HPFU = Health Professionals Follow-up Study; IHD = Ischemic Heart Disease; MI = Myocardial Infarction; MINAP = Myocardial Ischemia National Audit Project; NHS = Nurses Health Study; WHI = Women's Health Initiative.
Associations are presented per 5 µg/m^3 increase in pollutant concentration.

Table S6-14. Corresponding risk estimates for studies presented in Figure 6-18

Study	Cohort	Outcome	Years	Mean (µg/m^3)	Relative Risk (95% CI)
Miller et al. (2007)	WHI-Women (post-menopause) 36 Urban Sites, US	Stroke	1994-1998	13.4	1.13 (1.01, 1.27)
†Hart et al. (2015)	NHS- Women, 48 states, U.S.	Stroke	1989-2006	13.4	1.01 (0.96, 1.05)
†Lipsett et al. (2011)	CTS -Women, Los Angeles, California, U.S.	Stroke	1999-2005	15.6	1.07 (0.99, 1.15)

Study	Cohort	Outcome	Years	Mean (μg/m^3)	Relative Risk (95% CI)
†Puett et al. (2011)	HPFU, Men, 13 states, U.S.	IS	1988-2002	17.8	0.80 (0.61, 1.08)
†Puett et al. (2011)	HPFU, Men, 13 states, U.S.	HS	1988-2002	17.8	1.18 (0.74, 1.87)
†Hartiala et al. (2016)	Cardiac Patients, Ohio, U.S.	Stroke	1998-2010	15.5	1.17 (0.49, 2.87)
†Stafoggia et al. (2014)	ESCAPE- 11 Cohorts Europe	Stroke	2008-2011	7.3-31	1.19 (0.88, 1.62)
†Hoffmann et al. (2015)	HNR study, Ruhr area, Germany	Stroke	2008-2009	18.4	5.24 (1.39, 19.65)
†Atkinson et al. (2013)	GP Database, U.K.	Stroke	2003-2007	12.9	0.95 (0.87, 1.03)
†Koton et al. (2013)	8 Centers, Israel	Post MI Stroke	2003-2005	23.9	1.05 (0.71, 1.58)

†Studies publihsed since the 2009 PM Integrated Science Assessment.
CI = confidence interval; CTS = California Teachers Study; MI = Myocardial Infarction; IS = ischemic stroke; HS = hemorrhagic stroke; WHI = Women's Health Initiative; NHS = Nurses' Health Study; HPFU = Health Professional's Follow-up; ESCAPE = European Study of Cohorts for Air Pollution; HNR = Heinz Nixdorf Recall; GP = General Practitioner.
Associations are presented per 5 μg/m^3 increase in pollutant concentration.

Table S6-15. Corresponding risk estimates for studies presented in Figure 6-19

Study	Cohort	Notes	Years	Mean (µg/m^3)	Hazard Ratio (95% CI)
		CVD			
†Lepeule et al. (2012)	H6C		1974-2009	11.4-23.6	1.12 (1.07, 1.18)
†Ostro et al. (2015)	CA Teachers		2001-2007	17.9	1.03 (0.99, 1.06)
†Lipsett et al. (2011)	CA Teachers		2000-2005	15.6	1.03 (0.97, 1.09)
†Hart et al. (2011)	TrIPS	Whole cohort	1985-2000	14.1	1.03 (0.96, 1.09)
		Excluding long-haul drivers			1.03 (0.94, 1.12)
†Thurston et al. (2016)	NIH-AARP		2000-2009	10.2-13.6	1.05 (1.02, 1.07)
Miller et al. (2007)	WHI		1994-2003	13.4	1.33 (1.12, 1.57)
†Garcia et al. (2015)	CA cohort	Kriging	2006	13.06	1.04 (1.03, 1.05)
		IDW		12.94	1.05 (1.04, 1.06)
		Nearest monitor		12.68	1.03 (1.03, 1.04)
†Pope et al. (2014)	ACS		1982-2004	12.6	1.06 (1.05, 1.07)
†Crouse et al. (2012)	CanCHEC		1991-2001	11.2	1.08 (1.06, 1.09)
†Crouse et al. (2015)	CanCHEC	Extended	1991-2006	8.9	1.03 (1.02, 1.04)
†Pinault et al. (2016)	CCHS		1998-2011	6.3	1.09 (1.04, 1.15)
†Chen et al. (2016)	EFFECT		2001-2010	10.7	1.16 (1.04, 1.29)
†Weichenthal et al. (2014)	Ag Health		1993-2009	8.84	1.07 (0.87, 1.31)
		More precise exposure			1.14 (0.92, 1.43)
		IHD			
†Ostro et al. (2015)	CA Teachers		2001-2007	17.9	1.09 (1.04, 1.15)
†Ostro et al. (2010)	CA Teachers	Monitor within 30 km	2002-2007	17.5	1.70 (1.51, 1.92)
		Monitor within 8 km		17	1.84 (1.39, 2.44)
†Lipsett et al. (2011)	CA Teachers		2000-2005	15.6	1.10 (1.01, 1.19)
†Hart et al. (2011)	TrIPS	Whole cohort	1985-2000	14.1	1.01 (0.93, 1.09)

Study	Cohort	Notes	Years	Mean (μg/m^3)	Hazard Ratio (95% CI)
		Excluding long-haul drivers			0.99 (0.88, 1.10)
†Garcia et al. (2015)	CA cohort	Kriging	2006	13.06	1.11 (1.10, 1.12)
		IDW		12.94	1.13 (1.12, 1.15)
		Nearest monitor		12.68	1.10 (1.09, 1.11)
†Pope et al. (2014)	ACS		1982-2004	12.6	1.07 (1.05, 1.09)
		HF, cardiac arrest, related			1.05 (1.02, 1.09)
†Crouse et al. (2012)	CanCHEC		1991-2001	11.2	1.14 (1.13, 1.16)
†Crouse et al. (2015)	CanCHEC	Extended	1991-2006	8.9	1.09 (1.07, 1.10)
†Pinault et al. (2016)	CCHS		1998-2011	6.3	1.14 (1.06, 1.22)
†Chen et al. (2016)	EFFECT		2001-2010	10.7	1.20 (1.06, 1.35)
		AMI			1.28 (1.06, 1.55)
CHD					
Chen et al. (2005)	AHSMOG	Women	1977-1998	29	1.19 (1.03, 1.38)
		Men			0.95 (0.87, 1.02)
†Puett et al. (2011)	Health Prof		1989-2003	17.8	0.96 (0.79, 1.17)
†Puett et al. (2009)	Nurses Health		1992-2002	13.9	1.42 (1.03, 1.94)
Miller et al. (2007)	WHI	Definite CHD	1994-2003	13.4	1.49 (1.08, 2.04)
		Probable CHD			1.12 (0.79, 1.60)
†Gan et al. (2011)	Metro Vancouver		1999-2002	4.08	1.03 (0.94, 1.17)
Hypertension					
†Pope et al. (2014)	ACS		1982-2004	12.6	1.05 (0.98, 1.12)
Circulatory					
†Crouse et al. (2012)	CanCHEC		1991-2001	11.2	1.08 (1.06, 1.09)
CBVD					
†Lipsett et al. (2011)	CA Teachers		2000-2005	15.6	1.08 (0.96, 1.21)
Miller et al. (2007)	WHI		1994-2003	13.4	1.35 (1.05, 1.73)

Study	Cohort	Notes	Years	Mean (µg/m^3)	Hazard Ratio (95% CI)
†Pope et al. (2014)	ACS		1982-2004	12.6	1.05 (1.02, 1.08)
†Crouse et al. (2012)	CanCHEC		1991-2001	11.2	1.02 (0.99, 1.05)
†Crouse et al. (2015)		Extended	1991-2006	8.9	0.96 (0.94, 0.98)
†Pinault et al. (2016)	CCHS		1998-2011	6.3	1.11 (0.99, 1.25)

†Studies published since the 2009 PM Integrated Science Assessment.
ACS = American Cancer Society Cohort; AHSMOG = Adventist Health and Smog Study; AMI = acute myocardial infarction; avg = average; CanCHEC = Canadian Census Health and Environment Cohort; CBVD = cerebrovascular disease; CCHS = Canadian Community Health Survey; CHD = coronary heart disease; CI = confidence interval; CVD = cardiovascular disease; EFFECT = Enhanced Feedback For Effective Cardiac Treatment; HF = heart failure; H6C = Harvard Six Cities cohort; IDW = inverse distance weighting; IHD = ischemic heart disease; NIH-AARP = National Institutes of Health American Association of Retired Persons Diet & Health Cohort; NR = not reported; TrIPS = Trucking Industry Particle Study; WHI = Women's Health Initiative.
Associations are presented per 5 µg/m^3 increase in pollutant concentration.

Table S6-16. Corresponding risk estimates for studies presented in Figure 6-20

Study	Cohort	Outcome	Copollutant	Correlation	Relative Risk (95% CI)
†Puett et al. (2011)	HPFU Study	MI		NR	1.80 (0.90, 1.28)
			$PM_{10-2.5}$		1.03 (0.95, 1.12)
†Madrigano et al. (2013)	Worcester Heart Attack	MI			3.27 (2.08, 5.03)
			$PM_{2.5\ (local)}$	NR	3.52 (2.24, 5.39)
†Puett et al. (2011)	HPFU Study	Ischemic Stroke			0.80 (0.61, 1.08)
			$PM_{10-2.5}$	NR	0.69 (0.48, 0.95)
		Hemorrhagic Stroke			1.18 (0.74, 1.87)
			$PM_{10-2.5}$	NR	1.43 (0.83, 2.47)
†Fuks et al. (2014)	ESCAPE	Hypertension			1.03 (0.99, 1.07)
			NO_2	0.19-0.88	1.11 (1.00, 1.24)
		BPLM			1.06 (0.96, 1.17)
			NO_2	NR	1.09 (0.98, 1.23)

†Studies published since the 2009 PM Integrated Science Assessment.
CI = confidence interval; ESCAPE = European Study of Cohorts for Air Pollution; HPFU = Health Professionals Follow-up Study; BPLM = blood pressure lowering medication; MI = myocardial infarction; NHS = Nurses' Health Study; NR = not reported; NO_2 = nitrogen dioxide; $PM_{10-2.5}$ = particulate matter with a nominal aerodynamic diameter less than or equal to 10 µm and greater than a nominal diameter of 2.5 µm; $PM_{2.5}$ = particulate matter with a nominal aerodynamic diameter less than or equal to 2.5 µm.

Table S6-17. Corresponding risk estimates for studies presented in Figure 6-21

Study	Cohort	Copollutant	Correlation	Hazard Ratio (95% CI)
		CVD		
†Crouse et al. (2015)	CanCHEC			1.03 (1.02, 1.04)
		O_3	0.73	1.04 (1.03, 1.05)
†Jerrett et al. (2009)	ACS			1.07 (1.05, 1.09)
		O_3	0.64	1.10 (1.07, 1.12)
†Jerrett et al. (2013)	ACS – California			1.06 (1.02, 1.11)
		O_3	0.56	1.05 (1.01, 1.10)
†Thurston et al. (2016)	NIH-AARP			1.05 (1.02, 1.07)
		O_3	NR	1.03 (1.01, 1.06)
†Turner et al. (2016)	ACS			1.04 (1.03, 1.06)
		O_3	0.49	1.04 (1.02, 1.05)
		IHD		
†Crouse et al. (2015)	CanCHEC			1.09 (1.07, 1.10)
		O_3	0.73	1.10 (1.09, 1.11)
†Jerrett et al. (2009)	ACS			1.10 (1.08, 1.13)
		O_3	0.64	1.14 (1.11, 1.18)
†Jerrett et al. (2013)	ACS – California			1.10 (1.04, 1.17)
		O_3	0.56	1.09 (1.03, 1.15)
†Turner et al. (2016)	ACS			1.05 (1.03, 1.08)
		O_3	0.49	1.06 (1.04, 1.08)
		CHD		
Chen et al. (2005)	AHSMOG (Women)			1.19 (1.03, 1.38)
		O_3	0.60	1.41 (1.23, 1.62)
	AHSMOG (Men)			0.95 (0.87, 1.02)
		O_3	0.60	0.95 (0.88, 1.03)
		Circulatory		

Study	Cohort	Copollutant	Correlation	Hazard Ratio (95% CI)
†Turner et al. (2016)	ACS			1.04 (1.03, 1.06)
		O_3	0.49	1.04 (1.03, 1.06)
		CBVD		
†Crouse et al. (2015)	CanCHEC			0.96 (0.94, 0.98)
		O_3	0.73	0.96 (0.94, 0.99)
†Turner et al. (2016)	ACS			1.05 (1.02, 1.09)
			0.49	1.05 (1.01, 1.09)
		Dysrhythmia		
†Turner et al. (2016)	ACS			1.02 (0.98, 1.05)
		O_3	0.49	1.00 (0.97, 1.03)
		Stroke		
†Jerrett et al. (2013)	ACS – California			1.06 (0.99, 1.14)
		O_3	0.56	1.06 (0.99, 1.14)

†Studies published since the 2009 PM Integrated Science Assessment.
ACS: American Cancer Society Cohort; CanCHEC = Canadian Census Health and Environment Cohort; CI = confidence interval; NIH-AARP = National Institutes of Health American Association of Retired Persons Diet & Health Cohort; AHSMOG = Adventist Health Air Pollution Study; CVD = cardiovascular; IHD = ischemic heart disease; CHD = coronary heart disease; CBVD = cerebrovascular disease; CPD = cardiopulmonary disease; COPD = chronic obstructive pulmonary disease; NR = not reported; O_3 = ozone.
Associations are presented per 5 µg/m^3 increase in pollutant concentration.

Table S6-18. Corresponding risk estimates for studies presented in Figure 6-22

Study	Cohort	Copollutant	Correlation	Hazard Ratio (95% CI)
		CVD		
†Crouse et al. (2015)	CanCHEC			1.03 (1.02, 1.04)
		NO_2	0.40	1.06 (1.04, 1.07)
†Jerrett et al. (2013)	ACS – California			1.06 (1.02, 1.11)
		NO_2	0.55	1.04 (0.99, 1.10)
		IHD		
†Crouse et al. (2015)	CanCHECH			1.09 (1.07, 1.10)
		NO_2	0.40	1.12 (1.10, 1.14)

Study	Cohort	Copollutant	Correlation	Hazard Ratio (95% CI)
†Jerrett et al. (2013)	ACS – California			1.10 (1.04, 1.17)
		NO_2	0.55	1.08 (1.01, 1.16)
		CHD		
Chen et al. (2005)	AHSMOG (Men)			0.95 (0.87, 1.02)
		NO_2	0.25	0.92 (0.84, 1.02)
	AHSMOG (Women)			1.19 (1.03, 1.38)
		NO_2	0.25	1.18 (1.02, 1.37)
		CBVD		
†Crouse et al. (2015)	CanCHEC			0.96 (0.94, 0.98)
		NO_2	0.40	0.97 (0.95, 1.00)
		Stroke		
†Jerrett et al. (2013)	ACS – California			1.06 (0.99, 1.14)
		NO_2	0.55	1.02 (0.94, 1.11)
		Cardiometabolic		
†Crouse et al. (2015)	CanCHEC	NO_2	0.40	1.04 (1.03, 1.05)
				1.06 (1.05, 1.08)
		CHD		
†Puett et al. (2009)	Nurses Health Study			1.42 (1.03, 1.94)
		$PM_{10-2.5}$	--	1.46 (1.03, 2.06)
Chen et al. (2005)	AHSMOG (Women)			1.19 (1.03, 1.38)
		SO_2	0.30	1.23 (1.08, 1.40)
	AHSMOG (Men)			0.95 (1.08, 1.40)
		SO_2	0.30	0.94 (0.85, 1.03)

†Studies published since the 2009 PM Integrated Science Assessment.
ACS = American Cancer Society Cohort; AHSMOG = Adventist Health Air Pollution Study; CanCHEC = Canadian Census Health and Environment Cohort; CVD = cardiovascular; IHD = ischemic heart disease; CHD = coronary heart disease; CBVD = cerebrovascular disease; NR = not reported; avg = average; CI = confidence interval; NR = not reported; NO_2 = nitrogen dioxide; $PM_{10-2.5}$ = particulate matter with a nominal aerodynamic diameter less than or equal to 10 µm and greater than a nominal diameter of 2.5 µm; SO_2 = sulfur dioxide.
Associations are presented per 5 µg/m^3 increase in pollutant concentration.

Table S6-19. Corresponding risk estimates for studies presented in Figure 6-31

Study	Location	Lag	Copollutant	Correlation	% Increase (95% CI)
†Samoli et al. (2013)[a]	10 European Med cities	0-5			0.33 (-0.78, 1.46)
			SO_2	--	-0.09 (-1.3, 1.13)
			NO_2	--	-0.17 (-1.27, 0.95)
			O_3	--	0.21 (-1.11, 1.55)
			$PM_{2.5}$	0.19-0.68	-0.28 (-1.36, 0.81)
†Janssen et al. (2013)	Netherlands	3			1.80 (-0.20, 3.70)
			$PM_{2.5}$	0.29	1.70 (-0.30, 3.80)
†Lee et al. (2015a)	11 East Asian cities	0-1			0.69 (0.05, 1.33)
			SO_2	--	0.46 (-0.09, 1.01)
			NO_2	--	0.37 (-0.12, 0.87)
			O_3	--	0.92 (0.14, 1.7)
			$PM_{2.5}$	--	0.14 (-0.15, 0.43)
†Chen et al. (2011)	3 Chinese cities (CAPES)	1			0.25 (0.1, 0.39)
			$PM_{2.5}$	0.28-0.53	0.13 (-0.03, 0.29)

†Studies published since the 2009 PM Integrated Science Assessment.
[a]Copollutant results only presented for a lag of 0-5 days.
avg = average; CAPES = China Air Pollution and Health Effects Study; CI = confidence interval; NO_2 = nitrogen dioxide; NR = not reported; O_3 = ozone; $PM_{2.5}$ = particulate matter with a nominal aerodynamic diameter less than or equal to 2.5 µm; SO_2 = sulfur dioxide.
% increases are standardized to a 10 µg/m^3 increase in 24-h average $PM_{10-2.5}$ concentrations.

Table S6-20. Corresponding risk estimates for studies presented in Figure 6-34

Study	Cohort	Outcome	Years	Mean (µg/m³)	Relative Risk (95% CI)
Miller et al. (2007)	WHI- 36 sites, U.S.	CVD Events	2000	NR	0.99 (0.95, 1.03)
†Hart et al. (2015)	NHS- 48 Contiguous, U.S.	CHD	1989-2006	8.7	1.06 (1.01, 1.11)
†Puett et al. (2011)	HPFU, 13 states, U.S.	MI	1988-2002	10.1	1.04 (0.90, 1.19)
†Cesaroni et al. (2014)	ESCAPE, Europe	IHD	2008-2011	NR	1.06 (0.98, 1.15)
†Hoffmann et al. (2015)	HNR Ruhr, Germany	Coronary Event	2008-2009		0.78 (0.33, 1.82)
†Tonne et al. (2015)	MINAP, U.K.	MI Readmission	2003-2010	8.6	1.24 (0.95, 1.61)

†Studies published since the 2009 PM Integrated Science Assessment.
CI = confidence interval; CTS = California Teachers Study; ESCAPE = European Study of Cohorts for Air Pollution; HPFU = Health Professionals Follow-up Study; IHD = Ischemic Heart Disease; HNR = Heinz Nixdorf Recall study; MINAP = Myocardial Ischemia National Audit Project; MI = Myocardial Infarction; NR=not reported; NHS = Nurses' Health Study; WHI = Women's Health Initiative.
Associations are presented per 5 µg/m³ increase in pollutant concentration.

Table S6-21. Corresponding risk estimates for studies presented in Figure 6-35

Study	Cohort	Outcome	Years	Mean (μg/m^3)	Relative Risk (95% CI)
†Puett et al. (2011)	HPFU, 13 states, U.S.	IS	1988-2002	10.1	1.10 (0.88, 1.37)
†Puett et al. (2011)	HPFU, 13 states, U.S.	HS	1988-2002	10.1	0.85 (0.56, 1.31)
†Hart et al. (2015)	NHS- 48 states, U.S.	Stroke	1989-2006	8.7	1.05 (1.00, 1.10)
†Hoffmann et al. (2015)	HNR Ruhr, Germany	Stroke	2008-2009	--	2.53 (0.65, 9.84)
†Stafoggia et al. (2014)	ESCAPE	Stroke	2008-2011	NR	1.02 (0.90, 1.16)

†Studies published since the 2009 PM Integrated Science Assessment.
CI = confidence interval; HS = hemorrhagic Stroke, IS = Ischemic Stroke, HPFU = Health Professionals Follow-up Study, NHS = Nurses' Health Study, NHR = Heinz Nixdorf Recall, ESCAPE = European Study of Air Pollution Exposure.
Associations are presented per 5 μg/m^3 increase in pollutant concentration.

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