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Supplemental Methods

General overview of the Cardiovascular Disease Policy Model-China

The Cardiovascular Disease (CVD) Policy Model-China is a computer-simulation, state-transition (Markov cohort) mathematical model of coronary heart disease (CHD) and stroke incidence, prevalence, mortality, non-cardiovascular deaths, and costs of health care in Chinese population aged 35-84 years old. This model has been used for CVD epidemiologic projections and effectiveness analysis of specific policy interventions.[1-4] Because air pollution was much severer in urban areas and no reliable $PM_{2.5}$ data was available for rural areas, we created an urban China version of the model with updated levels of traditional cardiovascular risk factors for projections. The model start year is 2010 and the model cycle length is one year. Simulations are at the sub-national population level. The standard model simulates a dynamic national population, adding waves of 35-year adults with each successive cycle.

The CVD Policy Model consists of three sub-models: the Demographic-Epidemiological model, the Bridge model and the Disease History model. The Demographic-Epidemiological model predicts CHD and stroke incidence and non-CVD mortality among subjects without CVD, stratified by age, sex, systolic blood pressure (SBP, <140, 140-159.9, ≥160 mmHg), body mass index (BMI, <25, 25-29.9, ≥30 kg/m^2), low density lipoprotein (LDL) cholesterol (<100, 100-129.9, ≥130 mg/dL) and high density lipoprotein (HDL) cholesterol levels (<40, 40-59.9, ≥60 mg/dL), and status of smoking (active smoker, non-smoker with exposure to environmental tobacco smoke, non-smoker without environmental exposure), diabetes (yes or no) and $PM_{2.5}$ exposures (yes or no) in urban Chinese population in ten-year age categories among those aged 35-84 years. Means and proportions of CVD risk factors were estimated from the China Cardiovascular Health Study and the China Multicenter Collaborative Study of Cardiovascular

Epidemiology (ChinaMUCA) for urban adults in 10-year age categories aged 35 to 84 years.[5, 6] An annual population-weighted average $PM_{2.5}$ level during the period of 2014-2015 was extracted in 190 cities with over 950 monitoring sites and was assumed as national $PM_{2.5}$ level in 2017.[7] All individuals were assigned the mean $PM_{2.5}$ exposure for urban China. Multivariable adjusted hazard ratios of SBP, LDL, HDL, BMI, smoking and diabetes for CHD, stroke, and non-CVD (non-CHD, non-stroke) death by age and sex were estimated from the China Multi-provincial Cohort Study (CMCS)[8] using a competing risk Cox proportional hazard model for each outcome.

For individuals in whom CVD develops, the Bridge Sub-model characterizes the initial CHD or stroke event (cardiac arrest, myocardial infarction, or angina) and its sequelae for 30 days. Then, the Disease History Sub-model predicts subsequent CVD events, coronary revascularization procedures, CVD mortality, and non-CVD mortality among patients with CVD, stratified by age, sex, and history of events. The general chronic CVD categories include CHD only, stroke only, and combined prior CHD and prior stroke. Each state and event has an annual probability of a recurrent event and/or transition to a different CVD state. The model assumes survivors persist in a chronic disease state without remission.

Stroke incidence[9, 10], mortality[11] and case-fatality[9] were obtained from other studies. The main outcomes predicted were CHD events (nonfatal and nonfatal first-ever and repeat episodes of stable and unstable angina, myocardial infarction, or cardiac arrest) and stroke events (nonfatal and fatal ischemic and hemorrhagic strokes). The CVD Policy Model-China defined CHD as myocardial infarction (ICD-9 410, 412 or ICD-10 I21, I22), angina and other CHD (ICD-9 411, 413 and 414, or ICD-10 I20, I23-I25), and a fixed proportion of “ill-defined” CVD coded events and deaths (ICD-9 codes 427.1, 427.4, 427.5, 428, 429.0, 429.1, 429.2, 429.9, 440.9 or ICD-10 I47.2, I49.0, I46, I50, I51.4, I51,5, I51.9, and I70.9).[12]

Stroke was defined by ICD-9 codes 430-438 (excluding transient ischemic attack) or ICD-10 I60-I69. Finally, starting with CHD and stroke case fatality obtained from the Beijing Sino-MONICA study.[9] The CVD Policy Model-China mortality projections were calibrated to fit with age-specific and overall CHD and stroke mortality numbers for the years 2010-2011 estimated by the China Center for Disease Control (CDC).[13]

Urban China population estimates

Estimates for the urban China population aged 35-84 years old by age and sex were based on the 6th China census conducted in 2010.[14] The impact of aging and growth on population were estimated based on by *World Population Prospects* by United Nation Population Division. Population projections by age and sex started in 2010 were based on historical estimates of population by age and sex using probabilistic projections up to 2100 of total fertility and life expectancy at birth by sex.[15]

Urban-rural ratio was estimated by *World Urbanization Prospects* by United Nation Population Division[16] using an established and robust extrapolation method. Last two empirical data points from two censuses were used to calculate the urban-rural ratio. The average annual rate of change in the urban-rural ratio between the last two data points was calculated and then extrapolated, assuming that the proportion urban follows a logistic path. Then empirical urban-rural growth differences from 148 countries with 2 million or more inhabitants were combined in a regression equation. The fitted regression line was used to calculate a hypothetical urban-rural growth difference for each level of an initial observed percentage urban. Starting from the most recent urban-rural growth difference of a particular country, the hypothetical urban-rural growth difference of all countries over a period of 25 years was converged. In China, urban was defined as cities and towns, excluding villages according to China census protocol.[14] The urban-rural ratio of China was 49.2% in 2010 and projected to increase from 55.6% in 2015 to 68.7% in 2030. Then urban population for year 2017-2030 was estimated by multiplying the projected total China population by urban-rural ratio (**Supplemental Table S1**).

Effects of traditional non-communicable disease (NCD) risk factors

For the standard CVD Policy Model-China, annual probability of first CVD events and non-CVD deaths conditioned on demographic and risk factors were estimated by analyzing the CMCS. The CMCS was a cohort study of 30,121 male and female participants aged 35-64 years and with no CVD at baseline in 1992-1993. Details could be found elsewhere.[8] These participants were recruited from 16 centers in 11 Chinese provinces using a multistage sampling method. Majority of participants (80.3%) were in urban areas and the remainder were in rural areas. Overall baseline participation rate was 82%. Baseline measurement of risk factors followed a standard protocol (WHO-MONICA protocol) and blood samples were processed at a central laboratory. Case-finding of new CHD and stroke events and non-cardiovascular deaths was first done by face-to-face interview. Events were ascertained by 1) detailed interview of participants or family members, 2) review of hospital records. These events were later adjudicated by investigators at the Beijing Institute for Heart, Lung, and Blood Vessel Diseases. After 1996, six centers ceased follow up because of completion of that national research project, but the remaining 10 centers (16,552 participants) were followed up through the end of 2002. Follow up rate was 86% for the centers followed all of 1992-2002, and 65% of the original cohort of 16 centers. Multivariable Cox proportional hazard ratios for SBP, diabetes, LDL, HDL, BMI, and active smoking were estimated from baseline measurements and ischemic and hemorrhagic events occurring over 159,400 person-years of observation in CMCS participants aged 35-74 years (**Supplemental Table S2**).[8] Significant ($P< 0.05$) age*risk factor coefficient interactions (higher risk at higher ages) were found for smoking in CMCS multivariable CHD models, SBP, and smoking in total stroke models, and smoking and diabetes in non-cardiovascular mortality models, so these were incorporated in age-specific risk coefficients.

Traditional NCD risk trend estimations (2017-2030)

Future traditional NCD risk factors trends for population aged 35-84 years were projected forward from 2017 to 2030 based on recent temporal trends from 1990 to 2009. Temporal trend estimations were based on repeated China Health and Nutrition Surveys (CHNS) from 1991 to 2009. The CHNS is repeated household survey which initiated in 1989 using a multistage, random cluster process to draw a sample of over 30,000 individuals in 15 provinces and municipal cities across China. Follow-ups were conducted continuously every two to four years to obtain repeated measures on health and nutrition, including traditional NCD risk factors. Data are available at http://www.cpc.unc.edu/projects/china.

After the participants have seated for at least 5 minutes, blood pressure (BP) was measured on the right arm by trained research staff. BP was measured three times at each survey visit using a standard mercury sphygmomanometer. Then SBP was calculated as the mean of the second two measurements. Weight and height was measured at each survey year for BMI calculation. Weight was measured to the nearest 0.01 kg with a balance-beam scale, and height to the nearest 0.10 cm using a stadiometer. BMI was calculated as weight in kilograms divided by the square of height in meters. Active smoking was defined as self-report of current smoking cigarettes.

Temporal SBP, BMI and active smoking trends were estimated using age-adjusted mixed linear random effects model with 10-year age groups. Due to limited participants aged over 75 years in CHNS, we combined the last two age groups together for trend estimates. Age-time interactions observed in trends for SBP, BMI, or active smoking were incorporated into age-specific risk factor trend projections. Both SBP and BMI were projected to increase over time except for SBP in the oldest age group. While linear declining trends of active smoking prevalence were observed for both male and female. Since the active smoking prevalence among female is relatively low. It was decided a priori that we assumed zero active smoking prevalence among female if the estimated coming active smoking prevalence would be lower than zero.

HDL and LDL trend analysis was not estimated from CHNS because serum lipid data were only available for year 2009. We assumed HDL and LDL changes would be mediated by the BMI trend.[1, 17] An increase of 1 kg/m^2 in BMI was associated with 2.75 mg/dL increase in LDL and 1.55 mg/dL decrease in HDL among male and 2.24 mg/dL increase in LDL and 0.77 mg/dL decrease in HDL among female, respectively. In this model analyses, diabetes was defined as a having a past diagnosis of diabetes, taking anti-diabetes medications, or a fasting glucose ≥126 mg/dL. Since blood sample was collected ever since 2009 in CHNS, diabetes prevalence recorded in the CHNS before 2009 might be underestimated without fasting glucose data. In order to address this issue, we assumed diabetes awareness (the proportion of self-reported diabetes among participants defined as diabetes) gradually increased over time. The number of diabetes before 2009 was estimated using the following formula: the number of diabetes = self-reported diabetes/diabetes awareness. Self-reported diabetes information was obtained from the CHNS, while diabetes awareness data were from the China Cardiovascular Health Study and the ChinaMUCA study, which defined diabetes in the same way as the CVD Policy Model. Then the prevalence of diabetes could be obtained as the proportion of the estimated number of diabetes over the total number of subjects in CHNS. Based on the calculated diabetes prevalence, we projected diabetes trend accordingly. The age-adjusted prevalence of diabetes from the China Cardiovascular Health study was 5.98% in 2000 and 8.33% from the China Cardiovascular Health Study and the ChinaMUCA in 2008. The awareness rate of diabetes grew from 36.1% to 59.8%. We assumed similar awareness change in the CHNS and then estimated diabetes prevalence using linear regression. The diabetes prevalence was projected to increase yearly by 0.187% in male and 0.125% in female (**Supplemental Table S3**).

Effects of long term $PM_{2.5}$ exposure

Reduction in $PM_{2.5}$ air pollution levels was associated with decreased cardiovascular event rates.[18] However, no previous studies were conducted in China to explore the relationship between long term $PM_{2.5}$ exposure and health outcomes. Therefore, relative risks of CHD, stroke and all-cause mortality associated with long term $PM_{2.5}$ exposure were obtained from a meta-analysis of cohort studies.[18, 19] Published studies addressing long term $PM_{2.5}$ exposure with CHD, stroke and all-cause mortality as outcomes were identified (**Supplemental Table S4**).[20-36] If multiple data derived from the same study, the study with the most incident cases was included. Relative risks (RRs) or hazard ratios (HRs) and their 95% confidence intervals (CIs) were extracted and uniformly standardized as 10 $\mu g/m^3$ increment of $PM_{2.5}$. The overall RRs and 95% CIs were pooled using a random-effects model via the DerSimonian-Laird method. The RRs (95% CIs) for a 10 $\mu g/m^3$ increase in long term $PM_{2.5}$ exposure were 1.06 (1.03-1.08) for all-cause mortality, 1.19 (1.10-1.30) for CHD mortality and 1.07 (1.01-1.13) for stroke mortality (**Supplemental Figure S1-S3**). These estimates were further incorporated into the model. Though an integrated-exposure function[37] developed for Global Burden Disease Study showed a non-linear $PM_{2.5}$-CVD relationship by age, due to limitation of model's characteristics, we assumed a uniform relative risk effect of $PM_{2.5}$ on all urban adults across age. It was likely to over-estimate the effect sizes among those at the highest levels of air pollution exposure using the linear function.

Epidemiologic input parameters and calibration

Prior to calibration (see below), CHD incidence in male and female aged 35-84 years with no prior CHD diagnosis was based on 10-year incidence rates from the China Hypertension Epidemiology Follow Up Study (CHEFS)[10] and calibrated to fit with CHD mortality and case-fatality assumptions. Incident stroke rates were also identified from the CHEFS.[10] Main CVD Policy Model-China 28-day case-fatality assumptions were estimated from pooled Beijing Sino-MONICA Study data from 1993-2004 (personal communication, Dong Zhao, MD, PhD, 2006) and the main age-specific CHD case-fatality rate assumptions were estimated from the overall rates. Self-reported history of a physician-diagnosed myocardial infarction and/or stroke was based on data from CHEFS. In CHEFS, each self-reported case of prevalent CVD was ascertained with chart review by study staff. Final epidemiologic parameter estimates are shown in **Supplemental Tables S5-6.**

In order to evaluate the accuracy of CVD Policy Model predictions over time, China stroke and CHD mortality estimates for ages 35-84 years were obtained from the China CDC.[13] In the calibration procedure, CHD and stroke parameters were calibrated separately. Starting with default incidence, case-fatality, and prevalence assumptions, the simulation model was run forward from year 2010 to 2016. Incidence and case-fatality inputs were iteratively calibrated primarily to match with age-specific mortality numbers in 2010 overall and within ten-year age groups (**Supplemental Tables S7-8**). After CHD and stroke mortality were satisfactorily calibrated, age and sex specific non-cardiovascular death rates were also calibrated so that the totals of cardiovascular and non-cardiovascular deaths fitted within the envelope of all-cause mortality based on China CDC data.[13]

Monte Carlo Simulations

Markov Monte Carlo analyses were performed to estimate a range of uncertainty surrounding the results of projected air quality improvement and traditional risk factor intervention scenarios. We assumed that the beta coefficient distributions of SBP, smoking and $PM_{2.5}$ on CHD deaths and stroke deaths were normally distributed. Standard deviations for the SBP and smoking beta coefficients came from the CMCS study and the standard deviation for the $PM_{2.5}$ beta coefficient came from a meta-analysis of air pollution studies (**Supplemental Table S2**). The beta coefficient distributions for SBP, smoking, and $PM_{2.5}$ were randomly and simultaneously sampled 1,000 times in the Monte Carlo simulations.

Sensitivity Analysis

In the main analysis, no $PM_{2.5}$ change in 2017-2030 was assumed as status quo case. However, the Global Burden of Disease – Major Air Pollution Sources (GBD MAPS) project has estimated that $PM_{2.5}$ in China would modestly reduce by 4 $\mu g/m^3$ from 2013 to 2030 under the business as usual scenario (current legislation and implementation status as of end of 2012 and twelfth five-year plan for environmental protection).[38] Thus a sensitivity analysis was conducted assuming a graded reduction trend over 2017-2030 as the base case. The starting level of $PM_{2.5}$ remained 61 $\mu g/m^3$ in 2017, and it will slowly reduce to 57.9 $\mu g/m^3$ in 2030, with an average annual decrease of 0.24 $\mu g/m^3$ estimated from GBD MAPS project.

A linear $PM_{2.5}$-CVD morality relationship assumption might overestimate the health benefits, thus additional sensitivity analysis was conducted to quantify the impact of attenuated relative risk on health benefits. A 10% and 20% diminished beta-coefficient for the association between $PM_{2.5}$ and CHD and stroke death was recalculated. In recalculation for 10% diminished beta-coefficient, the point estimate of $PM_{2.5}$ for CHD deaths changed from 0.0174 to 0.0157 and stroke deaths changed from 0.0068 to 0.0061, and were further incorporated into the model. We re-run the CVD Policy Model-China (**Supplemental Table S10 and S11**).

Supplemental Table S1. Estimated China urban population aged 35-84 years old during 2017-2030 according to *World Population Prospects* by Population Division, United Nation.

Year	Male	Female	Total
2017	214,357,359	206,957,964	421,315,323
2018	221,214,027	213,805,560	435,019,587
2019	228,483,453	221,030,198	449,513,652
2020	236,269,514	228,703,794	464,973,308
2021	244,183,114	236,467,837	480,650,951
2022	252,549,397	244,626,274	497,175,671
2023	261,167,065	252,978,094	514,145,160
2024	269,637,173	261,153,768	530,790,940
2025	277,640,682	268,853,018	546,493,700
2026	284,503,701	275,452,872	559,956,573
2027	290,753,757	281,438,995	572,192,751
2028	296,427,057	286,839,505	583,266,562
2029	301,588,483	291,731,420	593,319,904
2030	306,302,815	296,167,648	602,470,463

Supplemental Table S2. Beta coefficients for CHD and stroke estimated from China Multi-provincial Cohort Study (CMCS) and standard deviations for SBP, smoking and $PM_{2.5}$ for Monte Carlo simulation.

	SBP (1 mmHg)				Smoking (yes/no)				$PM_{2.5}$(1 μg/m^3)			
	CHD death		Stroke death		CHD death		Stroke death		CHD death		Stroke death	
	Main point estimate	Standard deviations	Main point estimate	Standard deviations	Main point estimate	Standard deviations	Main point estimate	Standard deviations	Main point estimate	Standard deviations	Main point estimate	Standard deviations
Males, years												
35-44	.0338	.0036	.0472	.0048	.5640	.1526	.2550	.1064	.0174	.0041	.0068	.0017
45-54	.0302	.0017	.0422	.0035	.6940	.1526	.2550	.1064	.0174	.0041	.0068	.0017
55-64	.0271	.0013	.0368	.0022	.8240	.1526	.2550	.1064	.0174	.0041	.0068	.0017
65-74	.0221	.0016	.0283	.0041	.9540	.1526	.2550	.1064	.0174	.0041	.0068	.0017
75-84	.0161	.0018	.0162	.0022	1.0840	.1526	.2550	.1064	.0174	.0041	.0068	.0017
Females, years												
35-44	.0319	.0036	.0433	.0048	.5890	.1526	.4450	.2707	.0174	.0041	.0068	.0017
45-54	.0303	.0015	.0420	.0032	.8400	.1526	.4450	.2707	.0174	.0041	.0068	.0017
55-64	.0265	.0013	.0358	.0022	.9200	.1526	.4450	.2707	.0174	.0041	.0068	.0017
65-74	.0216	.0015	.0267	.0021	1.1000	.1526	.4450	.2707	.0174	.0041	.0068	.0017
75-84	.0159	.0017	.0159	.0021	1.1700	.1526	.4450	.2707	.0174	.0041	.0068	.0017

Supplemental Table S3. Annual future changes of traditional NCD risk factors were estimated based on China Health and Nutrition Survey.

	SBP (mmHg)	BMI (kg/m^2)	Smoking (%)	HDL (mg/dL)	LDL (mg/dL)	Diabetes (%)
Male, years						+0.187
35-44	+0.394	+0.121	-1.54	-0.188	+0.333	
45-54	+0.381	+0.117	-0.63	-0.181	+0.322	
55-64	+0.121	+0.092	-0.20	-0.143	+0.530	
65-84	-0.026	+0.088	-0.09	-0.136	+0.242	
Female, years						+0.125
35-44	+0.224	+0.054	-0.12	-0.042	+0.121	
45-54	+0.263	+0.087	-0.19	-0.067	+0.195	
55-64	+0.235	+0.095	-0.32	-0.073	+0.213	
65-84	-0.096	+0.111	-0.12	-0.085	+0.249	

Supplemental Table S4. Prospective studies exploring risk of long term $PM_{2.5}$ exposure and CHD, stroke and all-cause mortality.

Study	Population	Time period	Average $PM_{2.5}$ exposure level ($\mu g/m^3$)	RRs and 95% CIs with 10 $\mu g/m^3$ increment of $PM_{2.5}$		
				All-cause mortality	CHD mortality	Stroke mortality
Harvard six cities[20], 2012	Six cities in US	1974-2009	16	1.14 (1.07-1.22)		
ACS, extended I[21], 2004	Adults in metropolitan areas in US	1982-1998	17			1.02 (0.95-1.10)
ACS, extended II[22], 2009	Adults in metropolitan areas in US	1982-2000	14	1.06 (1.04-1.08)	1.24 (1.20-1.29)	
AHSMOG[23], 2000	Nonsmoking, non-Hispanic whites	1977-1992	NA	1.09 (0.97-1.21)		
VA study I[24], 2006	Hypertensive male veterans in US	1989-1996	19	1.15 (1.05-1.26)		
VA study II[25], 2006	Hypertensive male veterans in US	1997-2001	12	1.06 (0.94-1.22)		
CA CPS[26], 2005	11 counties in California, US	1973-1982	23	1.04 (1.01-1.07)		
CA CPS[26], 2005	11 counties in California, US	1983-2002	23	1.00 (0.98-1.02)		
WHI[27], 2007	Postmenopausal women in 36 US metropolitan areas	1994-2002	14		2.21 (1.17-4.16)	1.83 (1.11-3.00)
HPFS[28], 2011	Health professionals in US	1989-2003	18	0.86 (0.72-1.02)	0.98 (0.70-1.35)	
NHS[29], 2009	Registered nurses in US	1992-2002	14	1.26 (1.02-1.54)	2.02 (1.07-3.78)	
NLCS[30], 2008	Adults in 204 municipalities through Netherlands	1987-1996	28	1.06 (0.97-1.16)		
California Teachers Study[31], 2011	Female public school teachers in California, US	1997-2005	16			1.16 (0.92-1.46)
California Teachers Study[32], 2015	Female public school teachers in California, US	2001-2007	18	1.01 (0.97-1.05)	1.19 (1.08-1.31)	
US trucking industry cohort[33], 2011	Male employed in US trucking industry	1985-2000	14	1.10 (1.03-1.18)		
Canadian national cohort[34], 2012	Nonimmigrant Canadian adults	1991-2001	9	1.10 (1.05-1.15)	1.30 (1.18-1.43)	1.04 (0.93-1.16)
Rome Longitudinal Study[35], 2013	Italian population-based cohort	2001-2010	23	1.04 (1.03-1.05)	1.10 (1.06-1.13)	1.08 (1.04-1.13)
*ESCAPE study[36], 2014	22 cohorts across in Europe	1985-2007	7~31		0.98 (0.74-1.30)	1.21 (0.87-1.69)

US, the United States; ACS, American Cancer Society; AHSMOG, Adventist Health Study of Smog; VA, Veterans cohort; CA CPS, California Cancer Prevention Study; WHI, Women's Health Initiative; HPFS, Health Professionals Follow-up Study; NHS, Nurses' Health Study; NLCS, Netherlands Cohort Study on Diet and Cancer; ESCAPE, European Study of Cohorts for Air Pollution Effects.
*ESCAPE study includes 22 European cohorts using a standardized protocol for analysis.

Supplemental Table S5. Coronary Heart Disease (CHD) Inputs used for the CVD Policy Model-China

	CHD incidence rate per 100,000	CHD 28 day case-fatality (proportion)	CHD mortality per 100,000	Prevalence of prior myocardial infarction (proportion)
Males, years				
35-44	130	0.12	10	0.006
45-54	135	0.21	36	0.012
55-64	220	0.29	97	0.034
65-74	500	0.33	243	0.047
75-84	2,010	0.48*	1,104	0.060*
Females, years				
35-44	19	0.18	1	0.004
45-54	49	0.23	20	0.013
55-64	141	0.27	43	0.031
65-74	310	0.43	160	0.040
75-84	1,900	0.51*	1,028	0.060*

*Estimate not available from original source data and imputed using linear interpolation.

Supplemental Table S6. Stroke Inputs used for the CVD Policy Model-China

	Total stroke incidence rate per 100,000	Total stroke 28 day case-fatality (proportion)	Total stroke mortality per 100,000	Prevalence of prior stroke (proportion)
Males, years				
35-44	24	0.25	20	0.013
45-54	145	0.18	62	0.032
55-64	670	0.12	151	0.088
65-74	1,250	0.20	502	0.142
75-84	2,510	0.45*	1,708	0.150*
Females, years				
35-44	23	0.18	10	0.009
45-54	180	0.14	30	0.024
55-64	800	0.15	131	0.060
65-74	1,500	0.20	375	0.100
75-84	2,500	0.45*	1,359	0.120*

*Estimate not available from original source data and imputed using linear interpolation.

Supplemental Table S7. Pre-calibration and post-calibration CHD incidence and 28 day case-fatality inputs

	CHD incidence rate per 100,000		CHD 28 day case-fatality (proportion)	
	Pre-calibration (based on CHEFS, 1991-2000, ICD9 430-438)	Post-calibration (identical CVDPM definition)	Pre-calibration (based on Sino-Monica Beijing)	Post-calibration (identical CVDPM definition)
Males, years				
35-44	54	130	0.12	0.05
45-54	112	135	0.21	0.15
55-64	342	220	0.29	0.18
65-74	540	500	0.33	0.25
75-84	889	2,010	0.48*	0.50
Females, years				
35-44	23	19	0.18	0.14
45-54	96	49	0.23	0.20
55-64	188	141	0.27	0.20
65-74	368	310	0.43	0.46
75-84	752	1,900	0.51*	0.47

*Estimate not available from original source data and imputed using linear interpolation.

Supplemental Table S8. Pre-calibration and post-calibration stroke incidence and 28 day case-fatality inputs

	Stroke incidence rate per 100,000		Stroke 28 day case-fatality (proportion)	
	Pre-calibration (based on CHEFS, 1991-2000, ICD9 410-414)	Post-calibration (identical CVDPM definition)	Pre-calibration (based on Sino-Monica Beijing)	Post-calibration (identical CVDPM definition)
Males, years				
35-44	91	24	0.25	0.19
45-54	240	145	0.18	0.17
55-64	711	670	0.12	0.12
65-74	1,292	1,250	0.20	0.25
75-84	1,904	2,510	0.45*	0.48
Females, years				
35-44	59	23	0.18	0.11
45-54	176	180	0.14	0.11
55-64	424	800	0.15	0.12
65-74	848	1,500	0.20	0.22
75-84	1,500	2,500	0.45*	0.38

*Estimate not available from original source data and imputed using linear interpolation.

Supplemental Table S9. Sensitivity analysis for projected CHD and stroke deaths averted with hypothetical air pollution controls in urban Chinese population aged 35-84 years over 2017-2030 with business as usual scenario as status quo case

	CHD Deaths (thousands)	Averted CHD Deaths (thousands)	Stroke Deaths (thousands)	Averted Stroke Deaths (thousands)	Life years gained (thousands)
Alternative Status quo case†	7,604 (7,450-7,863)	-	10,902 (10,355-11,528)	-	
$PM_{2.5}$ improvement scenarios*					
Target 1: Beijing Olympic Games	7,462 (7,172-7,726)	143 (120-299)	10,824 (10,233-11,451)	78 (58-169)	1,115 (1,281-1,950)
Target 2: China Class II standard limit	6,216 (5,537-6,931)	1,388 (886-1,982)	10,080 (9,385-10,839)	823 (449-1,246)	11,620 (9,738-14,355)
Target 3: WHO recommended level	5,031 (4,122-6,089)	2,574 (1,701-3,403)	9,240 (8,330-10,314)	1,663 (914-2,399)	23,313 (19,526-27,682)
Comparison scenarios*					
25% reduction in uncontrolled systolic hypertension (to <140 mmHg)	6,915 (6,823-7,107)	689 (555-859)	9,657 (9,227-10,112)	1,245 (869-1,674)	9,911 (8,750-11,327)
30% reduction in tobacco use	7,210 (6,984-7,519)	394 (258-542)	10,788 (10,146-11,505)	115 (5-225)	3,034 (2,429-3,708)
25% reduction in uncontrolled systolic hypertension (to <140 mmHg) plus 30% reduction in tobacco use	6,560 (6,369-6,813)	1,044 (866-1,255)	9,559 (9,029-10,110)	1,343 (948-1,781)	12,774 (11,435-14,275)

† Alternative status quo case scenario ($PM_{2.5}$ remained 61 μg/m^3 in 2017, and it will slowly reduce to 57.9 μg/m^3 in 2030)
*Each scenario is compared with the status quo case. Ninety-five percent uncertainty intervals were calculated from the results of 1,000 probabilistic simulations.

Supplemental Table S10. Sensitivity analysis for projected CHD and stroke deaths averted with hypothetical air pollution controls in urban Chinese population aged 35-84 years over 2017-2030 with 10% attenuated $PM_{2.5}$-CVD health effects

	CHD Deaths (thousands)	Averted CHD Deaths (thousands)	Stroke Deaths (thousands)	Averted Stroke Deaths (thousands)	Life years gained (thousands)
Status quo case (remain current $PM_{2.5}$ level)	7,910 (7,741-8,094)	-	11,069 (10,219-11,611)	-	
$PM_{2.5}$ improvement scenarios*					
Target 1: Beijing Olympic Games	7,514 (7,291-7,693)	397 (206-616)	10,857 (10,049-11,406)	212 (92-323)	3,177 (2,629-3,822)
Target 2: China Class II standard limit	6,370 (5,672-7,016)	1,540 (845-2,258)	10,187 (9,408-10,814)	882 (392-1,317)	13,114 (11,018-15,467)
Target 3: WHO recommended level	5,253 (4,241-6,332)	2,657 (1,546-3,664)	9,422 (8,658-10,467)	1,647 (758-2,397)	24,280 (20,744-27,809)
Comparison scenarios*					
25% reduction in uncontrolled systolic hypertension (to <140 mmHg)	7,186 (7,117-7,235)	724 (591-905)	9,801 (9,159-10,129)	1,268 (808-1,642)	10,068 (8,929-11,237)
30% reduction in tobacco use	7,498 (7,257-7,704)	412 (306-562)	10,953 (9,955-11,563)	116 (30-273)	3,095 (2,623-3,831)
25% reduction in uncontrolled systolic hypertension (to <140 mmHg) plus 30% reduction in tobacco use	6,815 (6,629-6,899)	1,095 (953-1,265)	9,701 (8,924-10,102)	1,368 (958-1,726)	12,988 (12,036-14,320)

*Each scenario is compared with the status quo case. Ninety-five percent uncertainty intervals were calculated from the results of 1,000 probabilistic simulations.

Supplemental Table S11. Sensitivity analysis for projected CHD and stroke deaths averted with hypothetical air pollution controls in urban Chinese population aged 35-84 years over 2017-2030 with 20% attenuated $PM_{2.5}$-CVD health effects

	CHD Deaths (thousands)	Averted CHD Deaths (thousands)	Stroke Deaths (thousands)	Averted Stroke Deaths (thousands)	Life years gained (thousands)
Status quo case (remain current $PM_{2.5}$ level)	7,922 (7,780-8,066)	-	11,077 (10,547-11,305)	-	
$PM_{2.5}$ improvement scenarios*					
Target 1: Beijing Olympic Games	7,570 (7,265-7,933)	352 (100-551)	10,890 (10,348-11,132)	187 (95-326)	2,967 (2,128-3,803)
Target 2: China Class II standard limit	6,539 (5,718-7,608)	1,383 (422-2,050)	10,295 (9,530-10,727)	782 (409-1,326)	12,303 (8,970-15,437)
Target 3: WHO recommended level	5,504 (4,409-7,227)	2,418 (800-3,377)	9,608 (8,493-10,305)	1,470 (789-2,411)	22,892 (17,011-28,081)
Comparison scenarios*					
25% reduction in uncontrolled systolic hypertension (to <140 mmHg)	7,198 (7,119-7,307)	724 (595-850)	9,809 (9,291-10,135)	1,269 (877-1,490)	10,069 (8,907-10,925)
30% reduction in tobacco use	7,509 (7,323-7,719)	413 (266-508)	10,961 (10,339-11,277)	116 (34-239)	3,097 (2,584-3,666)
25% reduction in uncontrolled systolic hypertension (to <140 mmHg) plus 30% reduction in tobacco use	6,826 (6,683-6,996)	1,096 (926-1,244)	9,709 (9,088-10,106)	1,368 (998-1,618)	12,991 (11,636-13,907)

*Each scenario is compared with the status quo case. Ninety-five percent uncertainty intervals were calculated from the results of 1,000 probabilistic simulations.

Figure Legends

Supplemental Figure S1. Relative risks for each 10 μg/m^3 increment in long term $PM_{2.5}$ exposure and risk of all-cause mortality.

The horizontal lines represent 95% confidence interval and grey squares represent the weights of each study in random effect models.

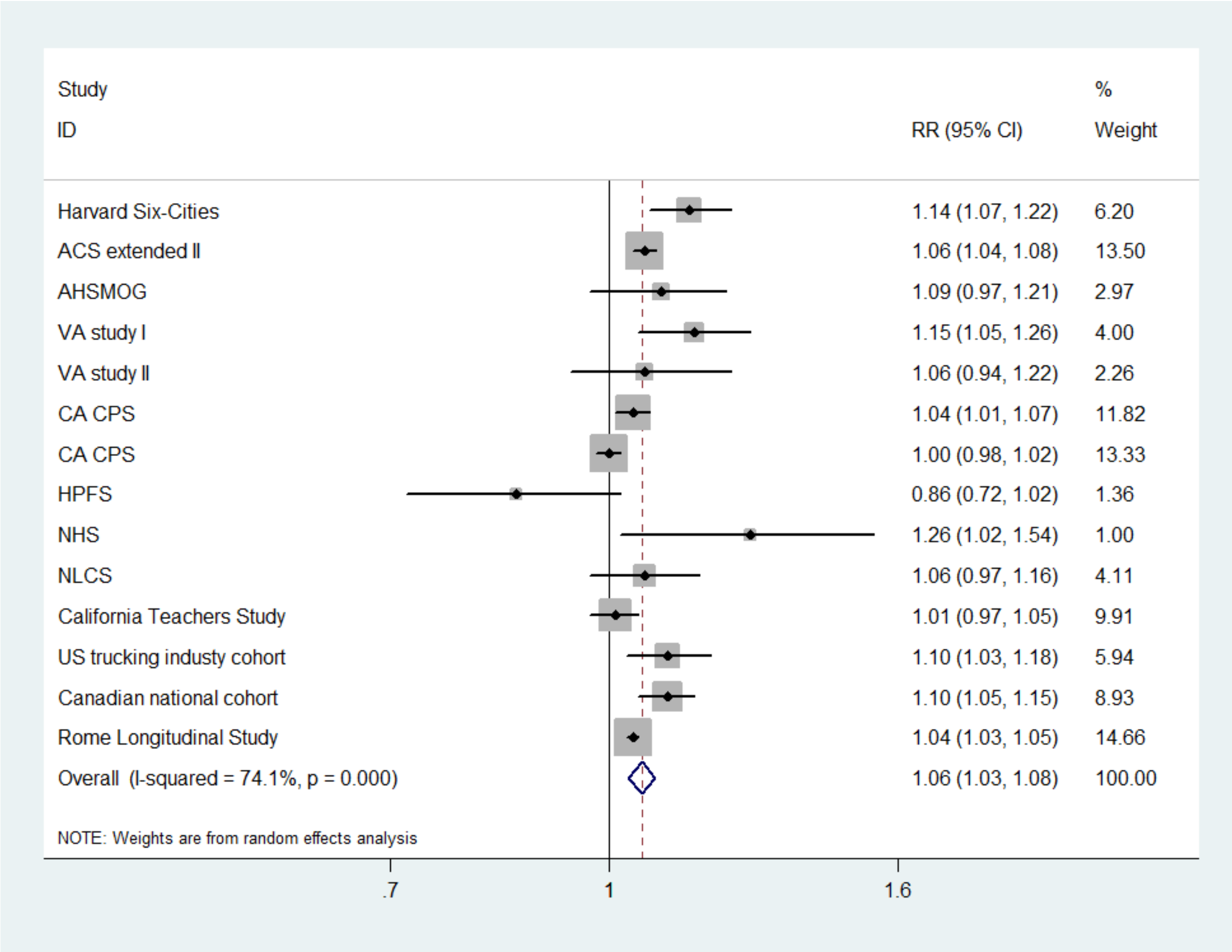
Supplemental Figure S2. Relative risks for each 10 μg/m^3 increment in long term $PM_{2.5}$ exposure and risk of coronary heart disease mortality.

The horizontal lines represent 95% confidence interval and grey squares represent the weights of each study in random effect models.

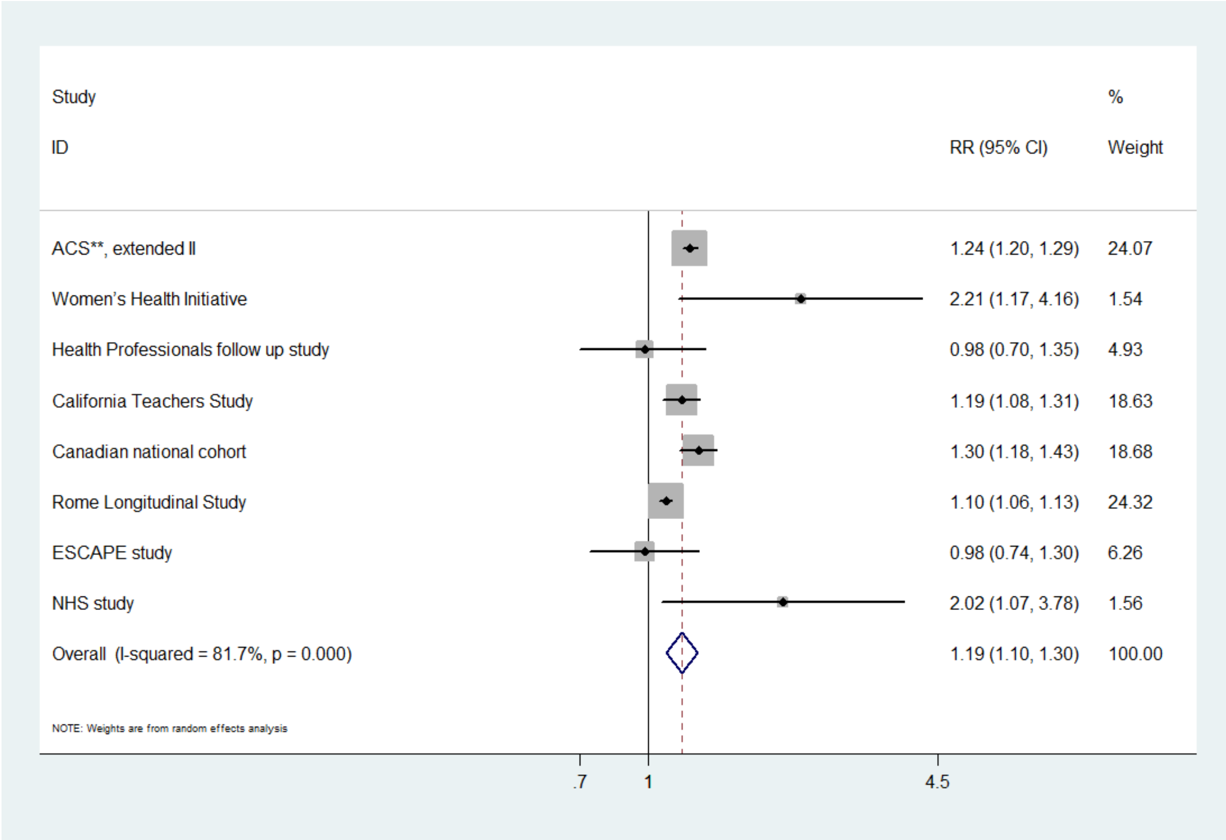
Supplemental Figure S3. Relative risks for each 10 μg/m^3 increment in long term $PM_{2.5}$ exposure and risk of stroke mortality.

The horizontal lines represent 95% confidence interval and grey squares represent the weights of each study in random effect models.

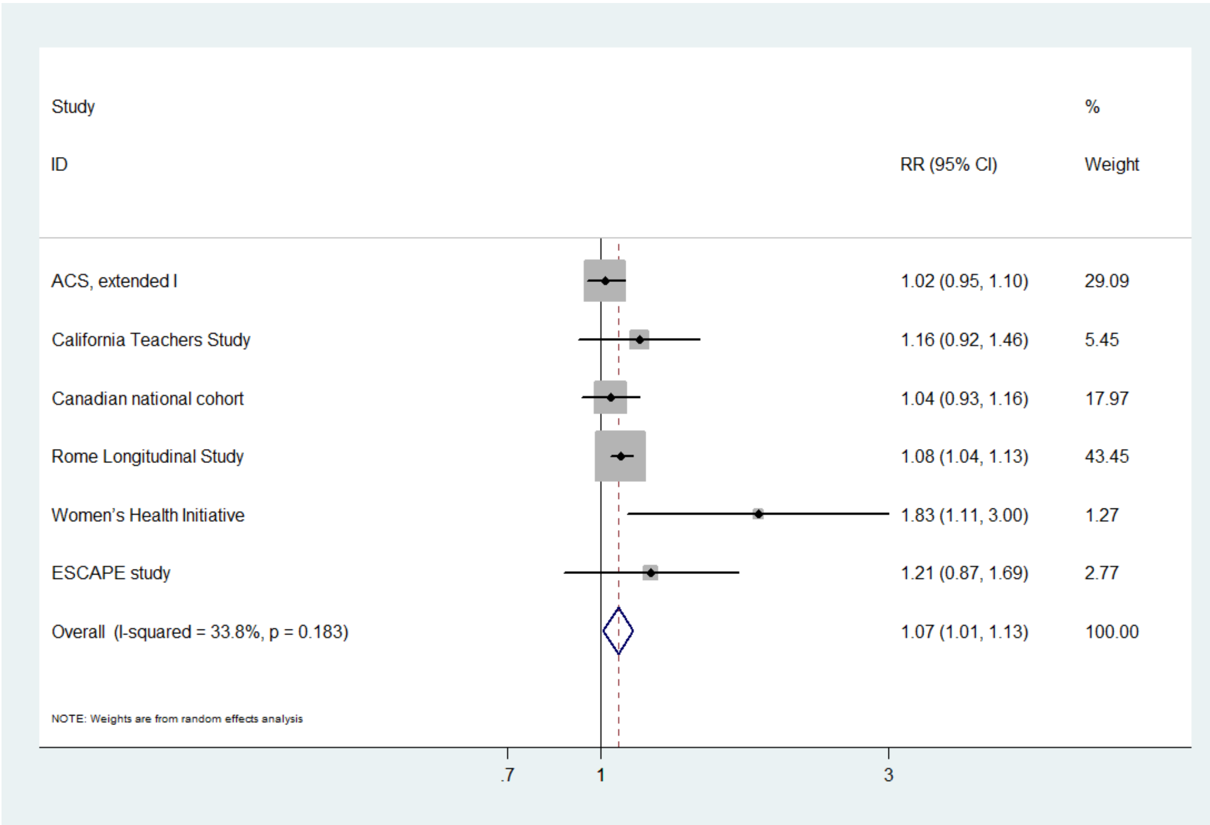
Supplemental Figure S1. Relative risks for each 10 μg/m^3 increment in long term $PM_{2.5}$ exposure and risk of all-cause mortality



Supplemental Figure S2. Relative risks for each 10 μg/m^3 increment in long term $PM_{2.5}$ exposure and risk of coronary heart disease mortality



Supplemental Figure S3. Relative risks for each 10 μg/m^3 increment in long term $PM_{2.5}$ exposure and risk of stroke mortality



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