Fine particle constituents and mortality: a time-series study in Beijing, China

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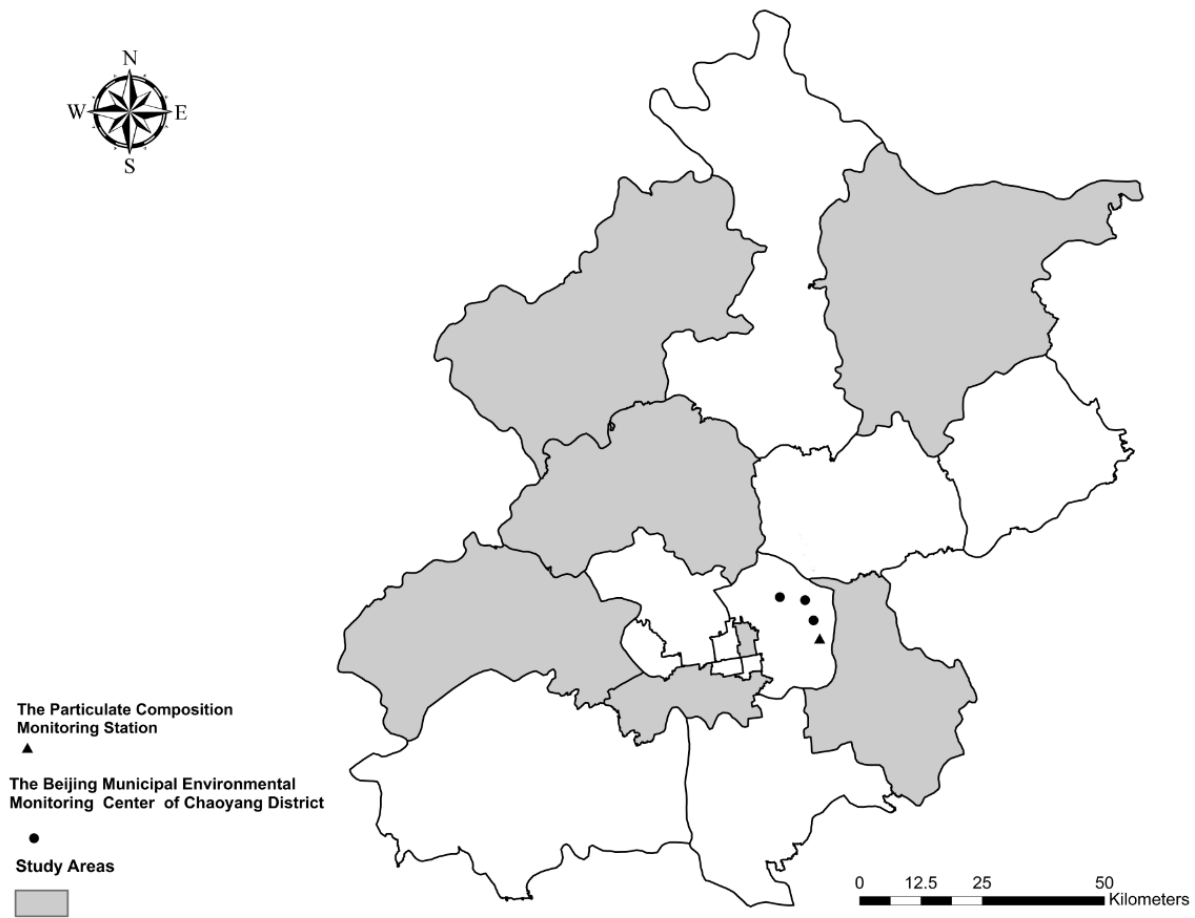
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Supporting Information

Figure S1 Map of study areas and fixed-site monitors location

Table S1 Correlation coefficients between $PM_{2.5}$ and chemical constituents

	OC	EC	Na$^+$	K$^+$	NH$_4^+$	Ca^{2+}	Mg^{2+}	Cl$^-$	NO$_3^-$	SO$_4^{2-}$
PM$_{2.5}$	0.78*	0.79*	0.05	0.13*	0.79*	0.11*	0.14*	0.63*	0.80*	0.80*
OC		0.84*	0.03	0.17*	0.62*	0.20*	0.16*	0.75*	0.63*	0.63*
EC			0.01	0.16*	0.66*	0.21*	0.12*	0.74*	0.67*	0.59*
Na$^+$				0.04	0.01	0.04	0.01	0.02	0.02	-0.01
K$^+$					0.12*	0.17*	0.28*	0.22*	0.17*	0.15*
NH$_4^+$						0.04	0.12*	0.53*	0.82*	0.65*
Ca^{2+}							0.13*	0.25*	0.09*	0.03
Mg^{2+}								0.31*	0.17*	0.20*
Cl$^-$									0.58*	0.54*
NO$_3^-$										0.70*

*Pearson correlation test, $p < 0.05$

Table S2 Percent increase (95% confidence interval) in mortality per IQR increase of $PM_{2.5}$ components at lag 0 day in sensitivity analysis for degrees of freedom[*]

$PM_{2.5}$ Components	$df_{\text{meteorological factors}} = 3$		$df_{\text{meteorological factor}} = 5$			Inclusion of $PM_{2.5}$
	$df_{\text{time}} = 6$	$df_{\text{time}} = 7$	$df_{\text{time}} = 5$	$df_{\text{time}} = 6$	$df_{\text{time}} = 7$	
$PM_{2.5}$	0.69 (-0.38, 1.77)	0.64 (-0.42, 1.72)	0.66 (-0.42, 1.76)	0.69 (-0.38, 1.78)	0.68 (-0.39, 1.76)	
OC	0.68 (-0.17, 1.54)	0.64 (-0.21, 1.50)	0.61 (-0.25, 1.47)	0.67 (-0.18, 1.53)	0.64 (-0.21, 1.50)	0.43 (-0.88, 1.75)
EC	0.78 (-0.17, 1.74)	0.75 (-0.20, 1.71)	0.83 (-0.13, 1.80)	0.79 (-0.17, 1.75)	0.77 (-0.19, 1.73)	0.85 (-0.60, 2.33)
Na^+	-0.11 (-0.21, 0.00)	-0.10 (-0.21, 0.00)	-0.09 (-0.20, 0.02)	-0.11 (-0.22, -0.01)	-0.11 (-0.21, 0.00)	-0.09 (-0.20, 0.01)
K^+	0.02 (-0.12, 0.15)	-0.02 (-0.16, 0.12)	0.06 (-0.08, 0.19)	0.02 (-0.11, 0.16)	-0.02 (-0.15, 0.12)	0.03 (-0.11, 0.17)
NH_4^+	0.29 (-0.83, 1.43)	0.14 (-0.97, 1.26)	0.41 (-0.72, 1.55)	0.29 (-0.83, 1.43)	0.18 (-0.94, 1.31)	-0.19 (-1.76, 1.40)
Ca^{2+}	0.23 (-0.24, 0.71)	0.18 (-0.3, 0.66)	0.32 (-0.16, 0.79)	0.24 (-0.24, 0.72)	0.17 (-0.31, 0.66)	0.25 (-0.23, 0.73)
Mg^{2+}	0.04 (-0.03, 0.11)	0.03 (-0.05, 0.10)	0.05 (-0.02, 0.13)	0.04 (-0.03, 0.11)	0.03 (-0.05, 0.10)	0.05 (-0.03, 0.12)
Cl^-	-0.17 (-1.00, 0.66)	-0.13 (-0.96, 0.70)	-0.13 (-0.96, 0.71)	-0.18 (-1.01, 0.65)	-0.16 (-0.98, 0.68)	-0.75 (-1.78, 0.30)
NO_3^-	0.44 (-0.38, 1.27)	0.29 (-0.54, 1.12)	0.52 (-0.30, 1.35)	0.45 (-0.38, 1.29)	0.32 (-0.51, 1.15)	0.28 (-0.81, 1.39)
SO_4^{2-}	0.58 (-0.47, 1.65)	0.62 (-0.44, 1.69)	0.63 (-0.45, 1.71)	0.58 (-0.48, 1.65)	0.63 (-0.44, 1.70)	0.29 (-1.09, 1.69)

[*] Sensitive analysis in changes for the degrees of freedom specified in the smooth functions and including the linearly-controlled $PM_{2.5}$ mass.

Table S3 Summary model estimates of BDL sensitivity analysis*

PM$_{2.5}$ Components	Days of BDL	No. of daily data (cases)	Mean of daily value ($\mu g/m^3$)	SD ($\mu g/m^3$)	IQR ($\mu g/m^3$)	Model Estimate (95% confidence interval)
OC	16	1078	15.52	11.49	10.11	0.61(-0.24,1.48)
EC	43	1078	2.28	1.95	2.03	0.85(-0.11,1.81)
Na$^+$	247	1079	1.46	6.72	0.91	-0.09(-0.20,0.01)
K$^+$	196	1049	1.57	5.62	1.01	0.05(-0.08,0.18)
NH$_4^+$	24	1080	11.97	11.65	12.44	0.44(-0.67,1.57)
Ca^{2+}	142	1080	0.40	0.61	0.38	0.30(-0.17,0.78)
Mg^{2+}	434	1077	0.13	0.44	0.07	0.07(-0.03,0.18)
Cl$^-$	84	1082	2.34	3.28	2.87	-0.14(-0.97,0.70)
NO$_3^-$	16	1082	14.23	16.72	14.50	0.53(-0.28,1.35)
SO$_4^{2-}$	8	1083	18.42	18.19	20.10	0.62(-0.45,1.69)

* BDL was replaced by half of the detection limit values. The PM$_{2.5}$ components exposure at lag 0 day was involved in this model estimation.

Table S4 Summary model estimates of sensitivity analysis for extreme values of PM$_{2.5}$ constituents[*]

Pollutant	All-cause Mortality		Cardiovascular Mortality		Respiratory Mortality	
	Full dataset	**< 99th percentile**	**Full dataset**	**< 99th percentile**	**Full dataset**	**< 99th percentile**
PM$_{2.5}$	0.01(-0.00,0.02)	0.01(-0.01,0.02)	0.01(-0.01,0.03)	0.00(-0.02,0.03)	0.02(-0.02,0.06)	0.03(-0.01,0.07)
OC	0.06(-0.03,0.14)	0.06(-0.04,0.15)	0.03(-0.09,0.15)	0.07(-0.06,0.20)	0.26(0.02,0.50)	0.34(0.07,0.61)
EC	0.42(-0.05,0.89)	0.40(-0.13,0.94)	0.33(-0.34,1.00)	0.52(-0.24,1.28)	0.68(-0.70,2.08)	0.69(-0.88,2.29)
Na$^+$	-0.1(-0.22,0.02)	0.52(0.02,1.02)	-0.09(-0.25,0.08)	0.38(-0.34,1.11)	-0.22(-0.57,0.13)	2.18(0.84,3.54)
K$^+$	0.05(-0.08,0.18)	0.32(-0.04,0.68)	0.06(-0.13,0.25)	0.50(-0.01,1.01)	0.50(0.17,0.84)	1.61(0.61,2.61)
NH$_4^+$	0.04(-0.05,0.13)	0.06(-0.04,0.16)	0.07(-0.06,0.20)	0.13(-0.01,0.28)	0.11(-0.16,0.38)	0.25(-0.05,0.56)
Ca^{2+}	0.91(-0.36,2.19)	0.13(-1.71,2.01)	0.38(-1.43,2.23)	-1.44(-4.05,1.24)	5.62(1.92,9.45)	6.02(0.43,11.92)
Mg^{2+}	1.17(-0.39,2.76)	3.04(-1.99,8.32)	1.17(-1.07,3.46)	3.12(-3.95,10.71)	5.59(1.60,9.74)	16.4(1.26,33.80)
Cl$^-$	-0.05(-0.34,0.24)	0.15(-0.21,0.51)	0.02(-0.40,0.44)	0.30(-0.21,0.81)	0.59(-0.25,1.45)	1.01(-0.04,2.06)
NO$_3^-$	0.04(-0.02,0.09)	0.03(-0.04,0.10)	0.06(-0.02,0.14)	0.08(-0.02,0.18)	0.11(-0.06,0.27)	0.11(-0.1,0.32)
SO$_4^{2-}$	0.03(-0.02,0.08)	0.03(-0.03,0.09)	0.08(0.00,0.15)	0.10(0.01,0.18)	0.13(-0.03,0.28)	0.15(-0.03,0.33)

[*] Model estimates were presented as percentage increase (95% confidence interval) in mortality for per pollutant 1ug/m^3 increase at lag 0 day.

Extreme values were defined as the 99th percentile of the pollutant's daily concentration and above during three-year time series.