

Supplemental material

Long-term exposure to PM_{2.5} components and mortality in 237 Chinese cities: a modelling study

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Table S1. Inter-quartile range (IQR) values of PM_{2.5} components across different lag periods.

Lag (year)	EC ($\mu\text{g}/\text{m}^3$)	OC ($\mu\text{g}/\text{m}^3$)	SO ₄ ²⁻ ($\mu\text{g}/\text{m}^3$)	NO ₃ ⁻ ($\mu\text{g}/\text{m}^3$)	NH ₄ ⁺ ($\mu\text{g}/\text{m}^3$)
lag 0	0.71	4.14	3.53	6.01	3.56
lag 1	0.78	4.47	3.92	6.24	3.69
lag 2	0.89	5.08	4.33	6.70	4.02
lag 3	1.00	5.44	5.01	7.08	4.50
lag 4	1.10	5.87	5.60	7.47	4.82
lag 0–1	0.74	4.27	3.70	6.15	3.67
lag 0–2	0.78	4.52	3.91	6.30	3.70
lag 0–3	0.84	4.74	5.57	6.57	3.93
lag 0–4	0.89	4.93	4.47	6.76	4.14

Table S2. Spearman's correlation coefficients between air pollutants and meteorological factors during 2015–2019.

Variables	EC	OC	SO ₄ ²⁻	NO ₃ ⁻	NH ₄ ⁺	PM ₁₀	PM _{2.5}	CO	O ₃	SO ₂	NO ₂	Mean temperature	Relative humidity	Air pressure
EC	1.00	0.97**	0.95**	0.83**	0.87**	0.61**	0.74**	0.49**	0.21**	0.38**	0.57**	0.07*	0.05	0.29**
OC		1.00	0.96**	0.91**	0.93**	0.67**	0.79**	0.49**	0.28**	0.36**	0.60**	0.06*	0.04	0.35**
SO ₄ ²⁻			1.00	0.93**	0.95**	0.64**	0.80**	0.48**	0.29**	0.37**	0.61**	0.09*	0.10**	0.43**
NO ₃ ⁻				1.00	0.99**	0.75**	0.85**	0.48**	0.39**	0.39**	0.65**	-0.12**	-0.09*	0.44**
NH ₄ ⁺					1.00	0.74**	0.85**	0.50**	0.35**	0.40**	0.64**	-0.06*	-0.05	0.40**
PM ₁₀						1.00	0.87**	0.56**	0.44**	0.58**	0.67**	-0.36**	-0.45**	0.12**
PM _{2.5}							1.00	0.58**	0.36**	0.51**	0.69**	-0.12**	-0.15**	0.34**
CO								1.00	0.09*	0.58**	0.47**	-0.04	-0.17**	0.07*
O ₃									1.00	0.10**	0.41**	-0.11**	-0.26**	0.31**
SO ₂										1.00	0.36**	-0.37**	-0.39**	-0.08*
NO ₂											1.00	-0.09*	-0.18**	0.32**
Mean temperature												1.00	0.79**	0.39**
Relative humidity													1.00	0.41**
Air pressure														1.00

Note: * P<0.05; ** P<0.001.

Table S3. Model fitting process based on Q-AIC.

Lag (year)	Q-AIC value
Single-year lags	
lag 0	722600.7
lag 1	717818.9
lag 2	704811.2
lag 3	698554.5
lag 4	718524.6
Cumulative lags	
lag 0–1	722356.7
lag 0–2	709121.4
lag 0–3	698167.9
lag 0–4	699600.6

Table S4. RR with 95% CI for total mortality associated with per IQR change in exposure to PM_{2.5} components during single-year lags (lag 0, 1, 2, 3 and 4 year) and cumulative-year lags (lag 0–1, 0–2, 0–3 and 0–4 year).

	EC	OC	SO ₄ ²⁻	NO ₃ ⁻	NH ₄ ⁺
lag 0	1.02 (0.97, 1.07)	1.02 (0.97, 1.08)	1.04 (0.98, 1.10)	1.07 (0.98, 1.16)	1.05 (0.97, 1.13)
<i>P</i> value	0.483	0.353	0.169	0.135	0.213
lag 1	1.03 (0.97, 1.09)	1.05 (0.99, 1.11)	1.07 (1.00, 1.14)	1.12 (1.02, 1.23)	1.08 (0.99, 1.17)
<i>P</i> value	0.295	0.127	0.055	0.019	0.069
lag 2	1.08 (1.03, 1.14)	1.09 (1.03, 1.15)	1.13 (1.06, 1.20)	1.10 (1.02, 1.19)	1.10 (1.02, 1.18)
<i>P</i> value	0.001	0.001	<0.001	0.015	0.011
lag 3	1.06 (1.01, 1.12)	1.08 (1.01, 1.15)	1.15 (1.06, 1.24)	1.12 (1.02, 1.23)	1.11 (1.01, 1.21)
<i>P</i> value	0.024	0.024	<0.001	0.016	0.028
lag 4	1.03 (0.97, 1.10)	1.06 (0.98, 1.14)	1.08 (0.99, 1.19)	1.05 (0.96, 1.16)	1.04 (0.94, 1.14)
<i>P</i> value	0.278	0.122	0.090	0.282	0.429
lag 0–1	1.03 (0.97, 1.09)	1.04 (0.98, 1.10)	1.07 (1.00, 1.14)	1.12 (1.01, 1.24)	1.08 (0.99, 1.18)
<i>P</i> value	0.319	0.178	0.065	0.032	0.086
lag 0–2	1.07 (1.01, 1.14)	1.08 (1.01, 1.15)	1.12 (1.04, 1.20)	1.15 (1.04, 1.28)	1.12 (1.02, 1.22)
<i>P</i> value	0.026	0.021	0.003	0.009	0.019
lag 0–3	1.09 (1.02, 1.16)	1.08 (1.01, 1.15)	1.16 (1.07, 1.25)	1.22 (1.08, 1.38)	1.16 (1.04, 1.29)
<i>P</i> value	0.012	0.009	<0.001	0.002	0.007
lag 0–4	1.10 (1.02, 1.19)	1.13 (1.04, 1.23)	1.19 (1.08, 1.31)	1.22 (1.08, 1.38)	1.18 (1.04, 1.34)
<i>P</i> value	0.013	0.005	<0.001	0.002	0.008

Table S5. RR with 95% CI for total mortality associated with per 1 $\mu\text{g}/\text{m}^3$ change in exposure to $\text{PM}_{2.5}$ components during single-year lags (lag 0, 1, 2, 3 and 4 year) and cumulative-year lags (lag 0–1, 0–2, 0–3 and 0–4 year).

	EC	OC	SO_4^{2-}	NO_3^-	NH_4^+
lag 0	1.03 (0.96, 1.10)	1.01 (0.99, 1.02)	1.01 (1.00, 1.03)	1.01 (1.00, 1.03)	1.01 (0.99, 1.04)
<i>P</i> value	0.483	0.353	0.169	0.135	0.213
lag 1	1.04 (0.97, 1.11)	1.01 (1.00, 1.02)	1.02 (1.00, 1.03)	1.02 (1.00, 1.03)	1.02 (1.00, 1.04)
<i>P</i> value	0.295	0.127	0.548	0.019	0.069
lag 2	1.09 (1.04, 1.15)	1.02 (1.01, 1.03)	1.03 (1.01, 1.04)	1.01 (1.00, 1.03)	1.02 (1.01, 1.04)
<i>P</i> value	0.001	0.001	<0.001	0.015	0.011
lag 3	1.06 (1.01, 1.12)	1.01 (1.00, 1.03)	1.03 (1.01, 1.04)	1.02 (1.00, 1.03)	1.02 (1.00, 1.04)
<i>P</i> value	0.024	0.024	<0.001	0.016	0.028
lag 4	1.03 (0.98, 1.09)	1.01 (1.00, 1.02)	1.01 (1.00, 1.03)	1.01 (0.99, 1.02)	1.01 (0.99, 1.03)
<i>P</i> value	0.278	0.122	0.090	0.282	0.429
lag 0–1	1.04 (0.96, 1.13)	1.01 (1.00, 1.02)	1.02 (1.00, 1.04)	1.02 (1.00, 1.03)	1.02 (1.00, 1.05)
<i>P</i> value	0.319	0.178	0.065	0.032	0.086
lag 0–2	1.09 (1.01, 1.18)	1.02 (1.00, 1.03)	1.03 (1.01, 1.05)	1.02 (1.01, 1.04)	1.03 (1.01, 1.06)
<i>P</i> value	0.026	0.021	0.003	0.009	0.019
lag 0–3	1.11 (1.02, 1.20)	1.02 (1.00, 1.04)	1.03 (1.01, 1.04)	1.03 (1.01, 1.05)	1.04 (1.01, 1.07)
<i>P</i> value	0.012	0.009	<0.001	0.002	0.007
lag 0–4	1.11 (1.02, 1.21)	1.02 (1.01, 1.04)	1.04 (1.02, 1.06)	1.04 (1.01, 1.06)	1.04 (1.01, 1.07)
<i>P</i> value	0.013	0.005	<0.001	0.002	0.008

Table S6. RR with 95% CI for total mortality associated with per IQR change in PM_{2.5} components at lag 0–3 year, adjusting for PM₁₀, CO, O₃, SO₂ and NO₂.

Air pollutants	RR (95%CI)	<i>P</i> value
EC		
+PM ₁₀	1.10 (1.02, 1.18)	0.008
+CO	1.09 (1.02, 1.16)	0.014
+O ₃	1.09 (1.02, 1.16)	0.012
+SO ₂	1.09 (1.02, 1.17)	0.014
+NO ₂	1.08 (1.01, 1.16)	0.020
OC		
+PM ₁₀	1.12 (1.03, 1.21)	0.005
+CO	1.10 (1.02, 1.19)	0.011
+O ₃	1.10 (1.03, 1.19)	0.008
+SO ₂	1.10 (1.02, 1.19)	0.010
+NO ₂	1.09 (1.02, 1.18)	0.018
SO₄²⁻		
+PM ₁₀	1.18 (1.08, 1.29)	<0.001
+CO	1.16 (1.07, 1.26)	<0.001
+O ₃	1.16 (1.07, 1.26)	<0.001
+SO ₂	1.16 (1.07, 1.26)	<0.001
+NO ₂	1.15 (1.06, 1.25)	<0.001
NO₃⁻		
+PM ₁₀	1.24 (1.09, 1.42)	0.001
+CO	1.22 (1.07, 1.39)	0.002
+O ₃	1.22 (1.08, 1.39)	0.002
+SO ₂	1.23 (1.08, 1.40)	0.002
+NO ₂	1.21 (1.07, 1.37)	0.003
NH₄⁺		
+PM ₁₀	1.18 (1.05, 1.32)	0.005
+CO	1.16 (1.04, 1.29)	0.008
+O ₃	1.16 (1.04, 1.29)	0.006
+SO ₂	1.16 (1.04, 1.30)	0.008
+NO ₂	1.15 (1.03, 1.28)	0.012

Table S7. Adjusted RR and 95%CI for the PM_{2.5} components per IQR change with the risk of mortality during different lags.

	EC	OC	SO ₄ ²⁻	NO ₃ ⁻	NH ₄ ⁺
lag 0	1.01 (0.96, 1.07)	1.02 (0.97, 1.07)	1.04 (0.98, 1.10)	1.05 (0.97, 1.15)	1.04 (0.96, 1.12)
<i>P</i> value	0.578	0.505	0.237	0.241	0.334
lag 1	1.03 (0.97, 1.09)	1.04 (0.98, 1.10)	1.06 (1.00, 1.14)	1.11 (1.01, 1.22)	1.08 (0.99, 1.17)
<i>P</i> value	0.329	0.160	0.064	0.029	0.087
lag 2	1.09 (1.04, 1.14)	1.10 (1.04, 1.16)	1.14 (1.07, 1.21)	1.10 (1.02, 1.20)	1.10 (1.02, 1.19)
<i>P</i> value	<0.001	0.001	<0.001	0.020	0.011
lag 3	1.07 (1.02, 1.13)	1.09 (1.02, 1.16)	1.16 (1.07, 1.26)	1.14 (1.03, 1.26)	1.12 (1.02, 1.23)
<i>P</i> value	0.012	0.016	<0.001	0.010	0.015
lag 4	1.04 (0.98, 1.11)	1.08 (1.00, 1.16)	1.11 (1.01, 1.22)	1.08 (0.98, 1.20)	1.06 (0.96, 1.18)
<i>P</i> value	0.183	0.057	0.037	0.130	0.240
lag 0-1	1.03 (0.97, 1.09)	1.04 (0.98, 1.10)	1.06 (0.99, 1.14)	1.10 (1.00, 1.22)	1.07 (0.98, 1.18)
<i>P</i> value	0.383	0.257	0.089	0.061	0.132
lag 0-2	1.07 (1.01, 1.14)	1.08 (1.01, 1.15)	1.12 (1.04, 1.21)	1.14 (1.03, 1.28)	1.12 (1.01, 1.23)
<i>P</i> value	0.030	0.029	0.003	0.016	0.027
lag 0-3	1.09 (1.02, 1.17)	1.10 (1.02, 1.18)	1.16 (1.07, 1.27)	1.22 (1.07, 1.39)	1.17 (1.04, 1.31)
<i>P</i> value	0.011	0.012	<0.001	0.003	0.007
lag 0-4	1.11 (1.03, 1.20)	1.13 (1.04, 1.24)	1.21 (1.09, 1.34)	1.30 (1.11, 1.52)	1.21 (1.06, 1.39)
<i>P</i> value	0.009	0.005	<0.001	0.001	0.005

Note: A differences-in-differences model was adjusted for summer and winter temperature by using natural splines with 3 degrees of freedom.

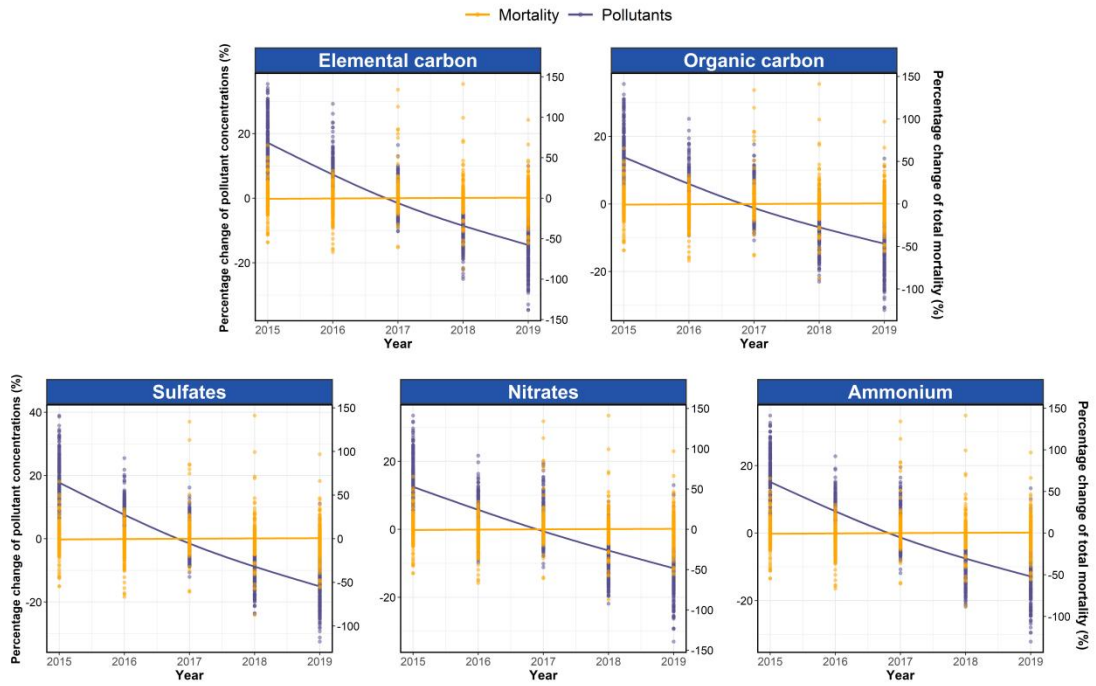


Figure S1. The percentage of relative changes in total mortality and the average concentrations of PM_{2.5} components in 237 cities during 2015–2019.