

## Supplementary Material

### **Cognitive impairment associated with individual and joint exposure to PM<sub>2.5</sub> constituents in a Chinese national cohort**

Boning Deng <sup>a, 1</sup>, Yachen Li <sup>a, 1</sup>, Lifeng Zhu <sup>a</sup>, Yuwei Zhou <sup>a</sup>, Aonan Sun <sup>a</sup>, Jingjing Zhang <sup>a</sup>, Yixiang Wang <sup>a</sup>, Yuxi Tan <sup>a</sup>, Jiajun Shen <sup>a</sup>, Yalin Zhang <sup>a</sup>, Zan Ding <sup>b, \*</sup>, Yunquan Zhang <sup>a, \*</sup>

<sup>a</sup> Institute of Social Development and Health Management, Hubei Province Key Laboratory of Occupational Hazard Identification and Control, School of Public Health, Wuhan University of Science and Technology, Wuhan 430065, China

<sup>b</sup> Baoan Central Hospital of Shenzhen, Shenzhen 518102, China

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<sup>1</sup> Boning Deng and Yachen Li shared co-first authorship and contributed equally to this work.

\* Corresponding author: Dr. Yunquan Zhang, School of Public Health, Wuhan University of Science and Technology, Wuhan 430065, China. E-mail: [YunquanZhang@wust.edu.cn](mailto:YunquanZhang@wust.edu.cn). phone number: +8613638620145

\* Corresponding author: Dr. Zan Ding, Baoan Central Hospital of Shenzhen, Shenzhen 518102, China. E-mail: [dingzan\\_1990@163.com](mailto:dingzan_1990@163.com)

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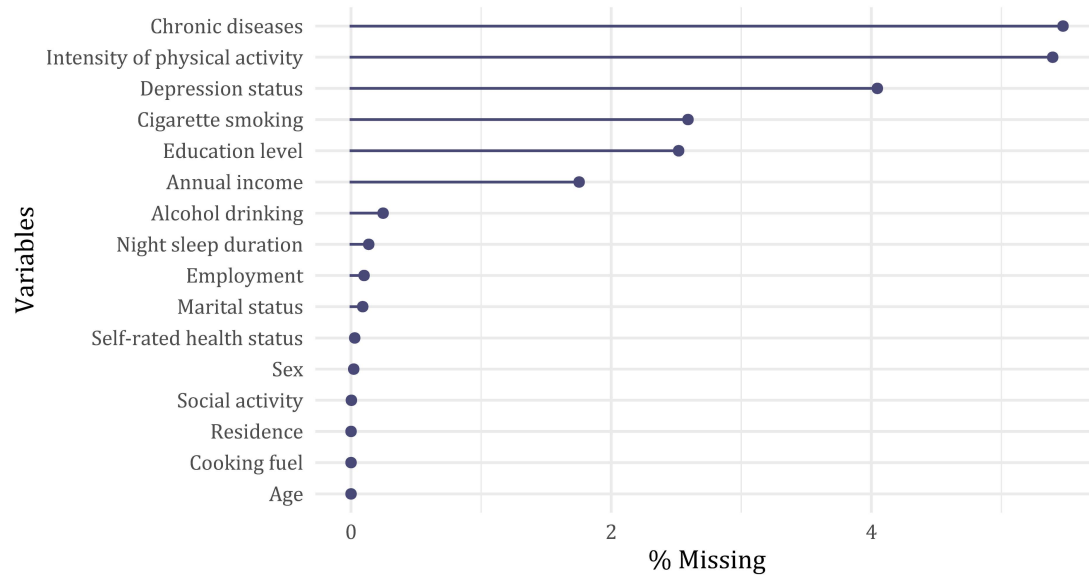
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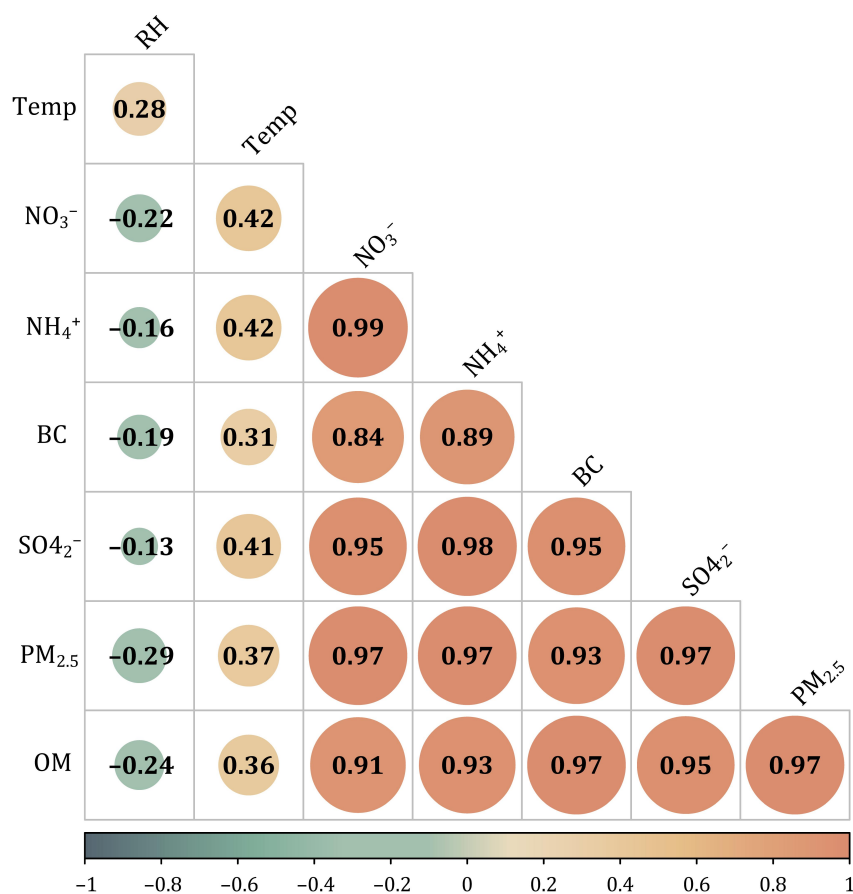
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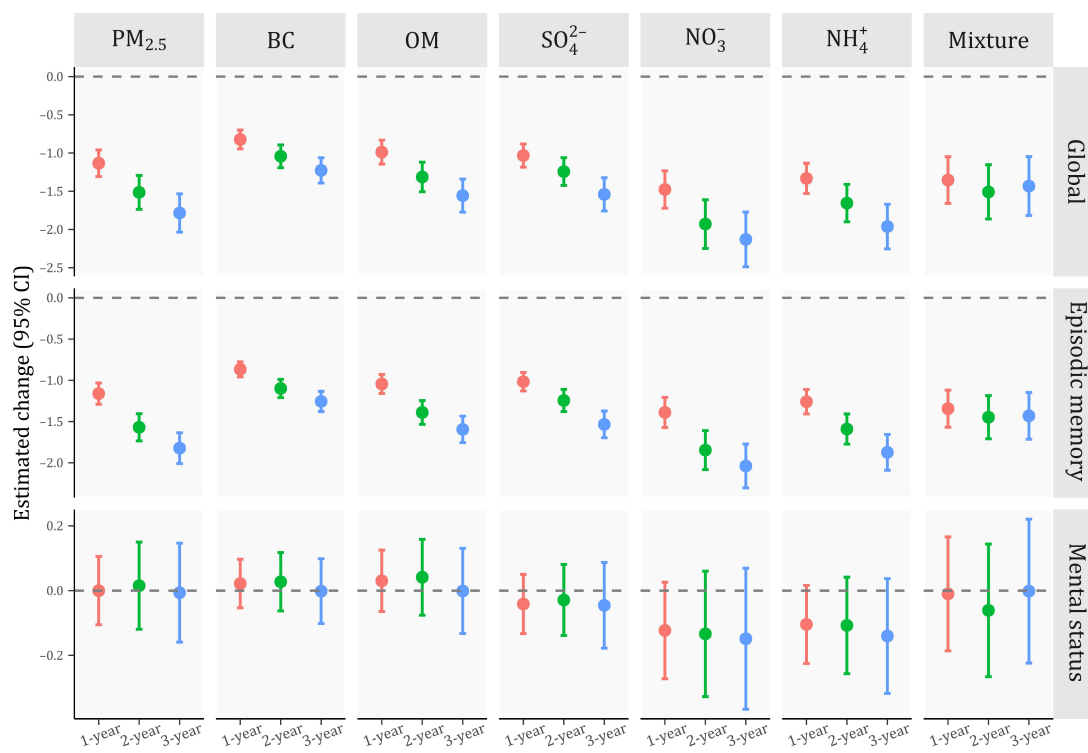
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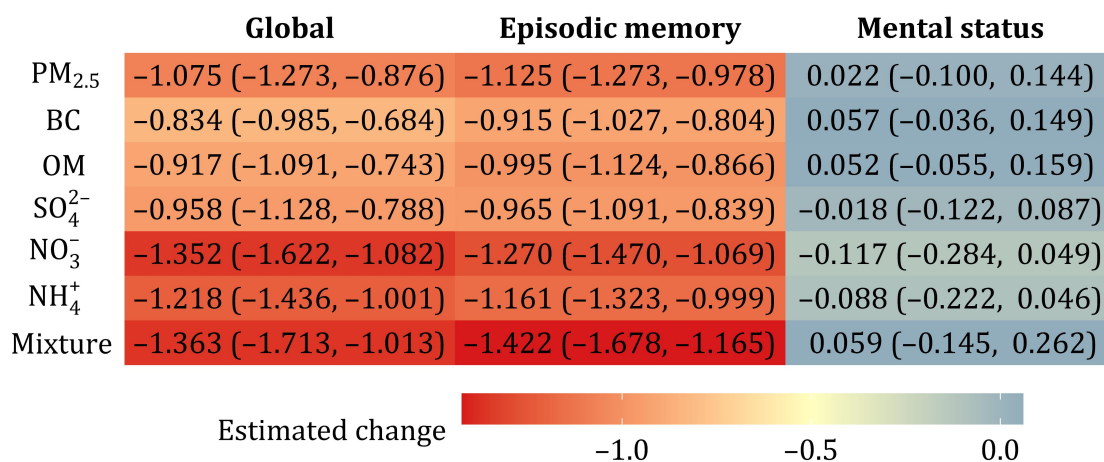
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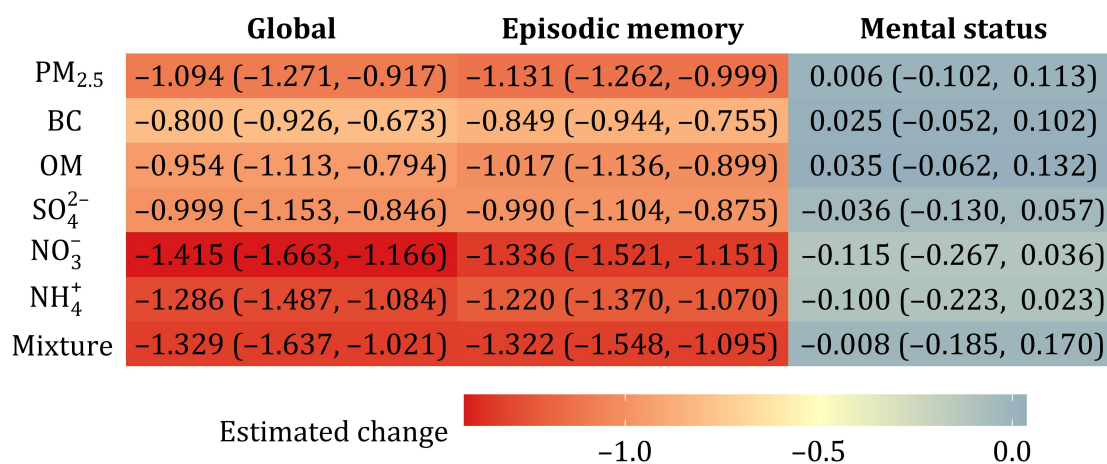
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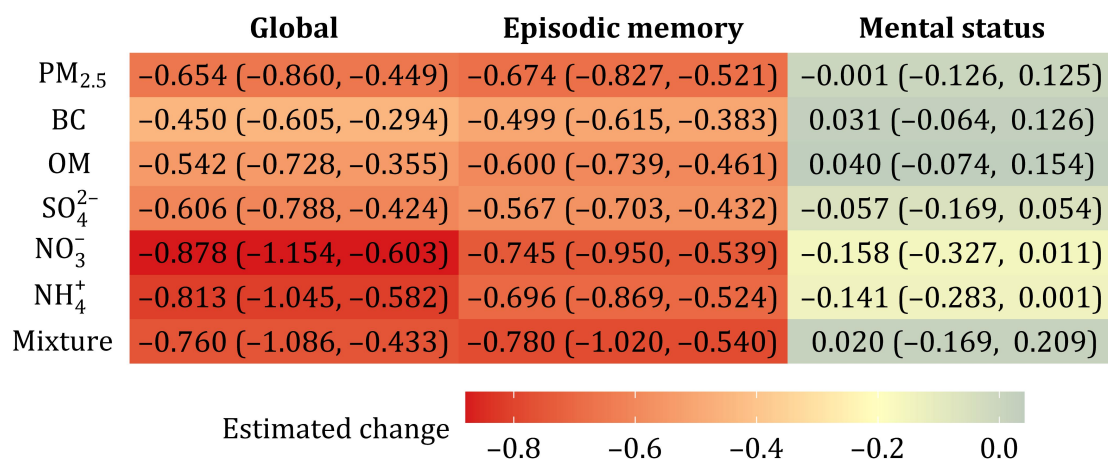
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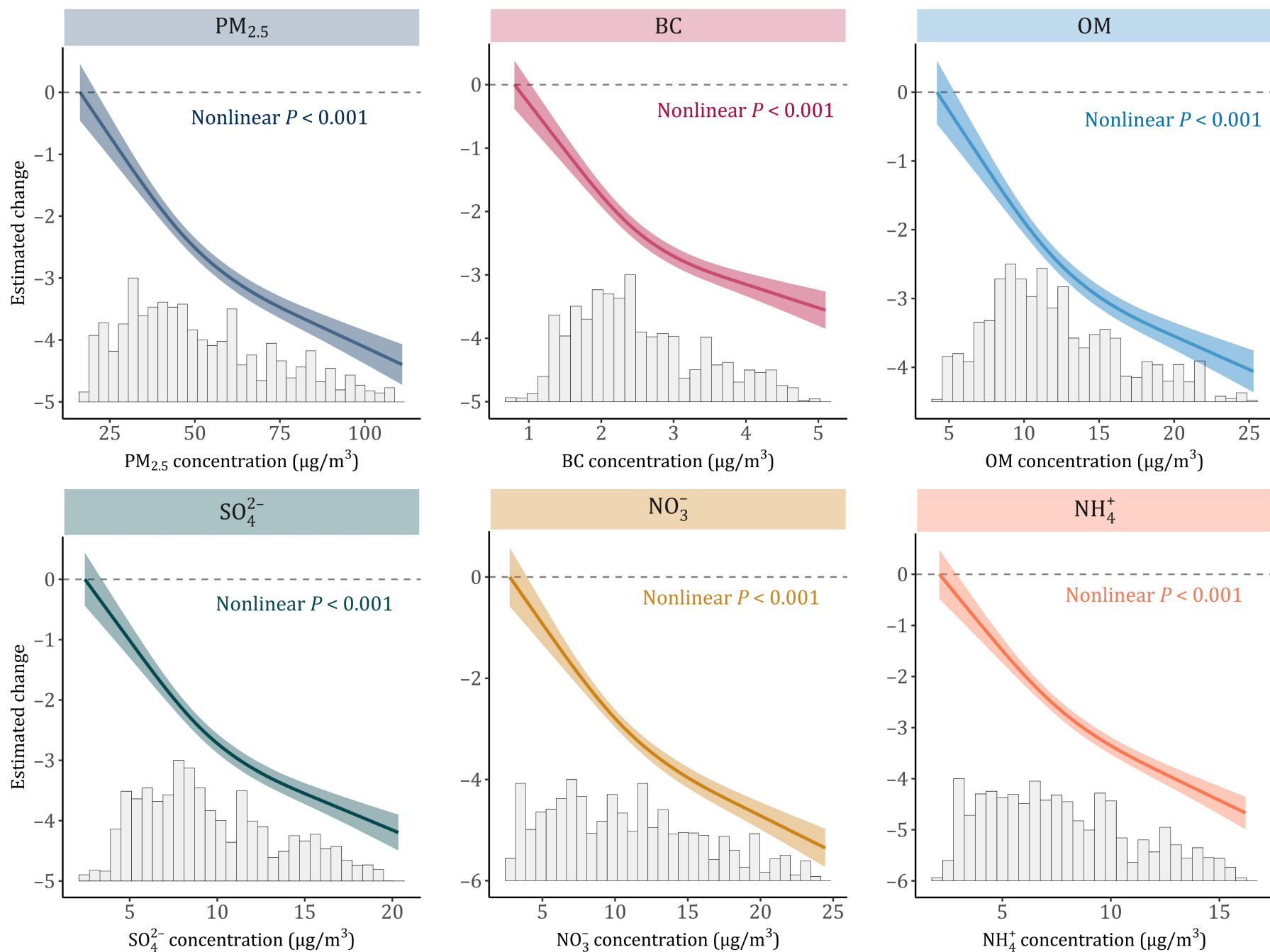
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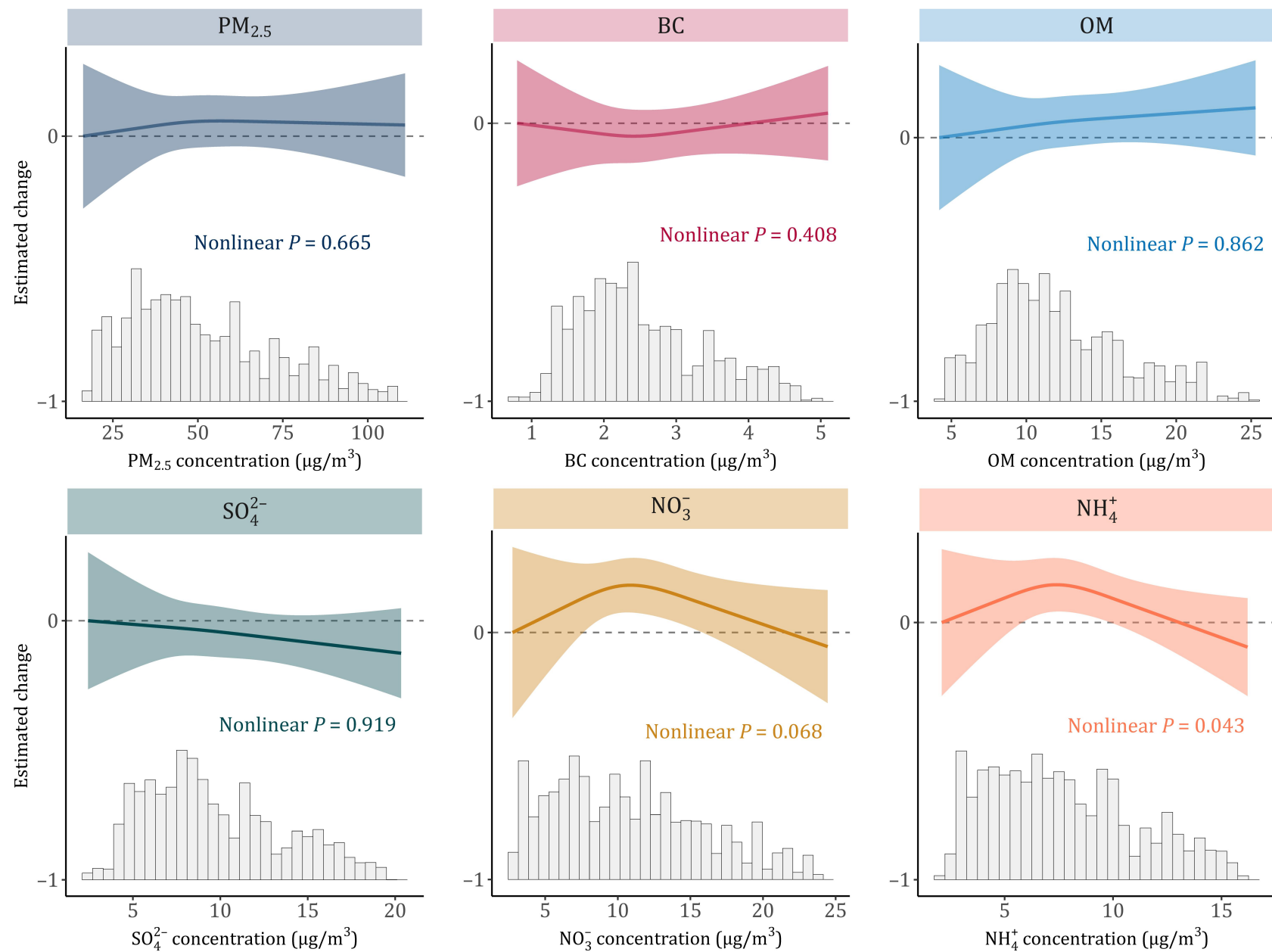
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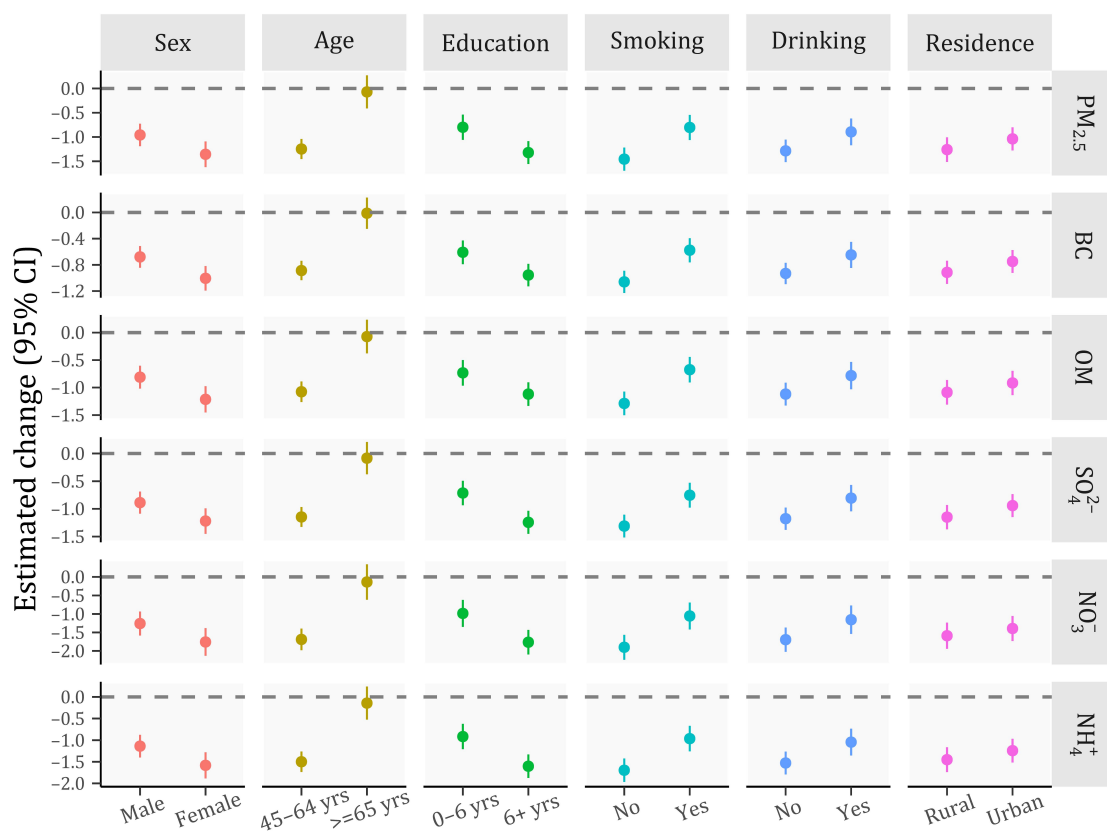
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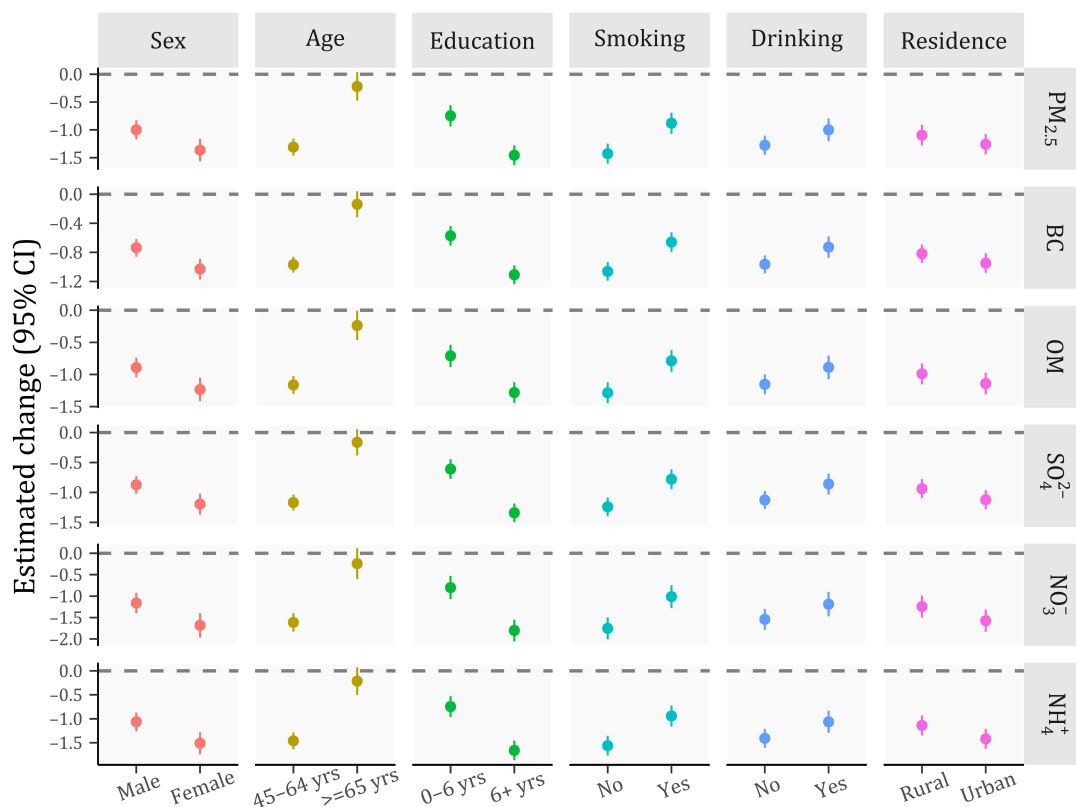
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**Fig. S8** Concentration-response associations of exposure to PM<sub>2.5</sub> and its constituents with changes in mental status score. Abbreviations: PM<sub>2.5</sub>, particulate matter with an aerodynamic diameter  $\leq 2.5 \mu\text{m}$ ; BC, black carbon; OM, organic matter; NO<sub>3</sub><sup>-</sup>, nitrate; SO<sub>4</sub><sup>2-</sup>, sulfate; NH<sub>4</sub><sup>+</sup>, ammonium.

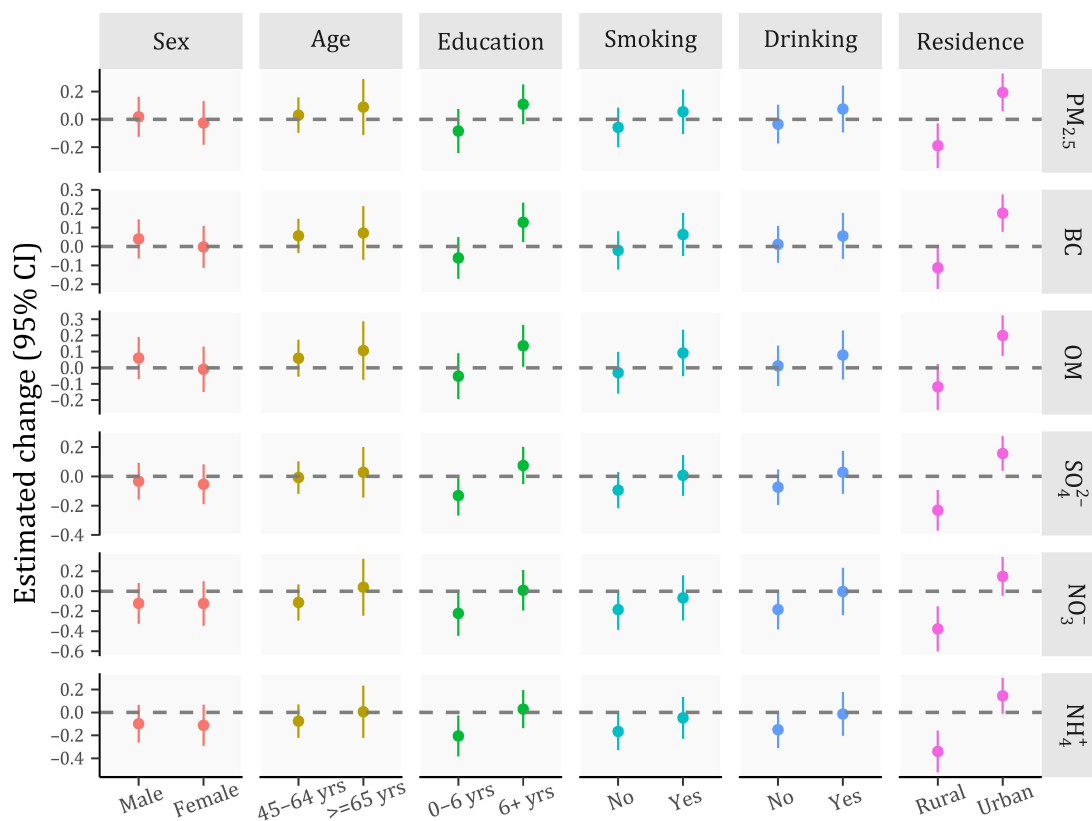


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**Fig. S10** Estimated changes in cognitive score of episodic memory associated with an IQR increase in individual exposure, stratified by participant characteristics.

Abbreviations: CI, confidence interval; IQR, interquartile range; PM<sub>2.5</sub>, particulate matter with an aerodynamic diameter  $\leq 2.5$   $\mu\text{m}$ ; BC, black carbon; OM, organic matter; NO<sub>3</sub><sup>-</sup>, nitrate; SO<sub>4</sub><sup>2-</sup>, sulfate; NH<sub>4</sub><sup>+</sup>, ammonium.



**Fig. S11** Estimated changes in cognitive score of mental status associated with an IQR increase in individual exposure, stratified by participant characteristics. Abbreviations: CI, confidence interval; IQR, interquartile range; PM<sub>2.5</sub>, particulate matter with an aerodynamic diameter  $\leq 2.5$   $\mu\text{m}$ ; BC, black carbon; OM, organic matter; NO<sub>3</sub><sup>-</sup>, nitrate; SO<sub>4</sub><sup>2-</sup>, sulfate; NH<sub>4</sub><sup>+</sup>, ammonium.

**Table S1** The test for reliability and validity of TICS questionnaire.

CHARLS wave	Reliability	Validity
2011	0.86	0.76
2013	0.88	0.80
2015	0.85	0.78
2018	0.85	0.68
2011–2018	0.85	0.76

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Abbreviations: TICS, Telephone Interview of Cognitive Status; CHARLS, China Health and Retirement Longitudinal Study.

**Table S2** AIC and BIC values of multivariable-adjusted single-pollutant models using restricted cubic spline function with selected choices for knots.

	<b>Knots</b>	<b>PM<sub>2.5</sub></b>	<b>BC</b>	<b>OM</b>	<b>SO<sub>4</sub><sup>2-</sup></b>	<b>NO<sub>3</sub><sup>-</sup></b>	<b>NH<sub>4</sub><sup>+</sup></b>	<b>Sum</b>
<b>AIC</b>	10th, 50th, 90th	225795.3	225762.4	225800.4	225768.5	225819.8	225787.3	1354733.6
	20th, 50th, 80th	225794.0	225762.8	225800.1	225765.1	225821.3	225788.5	1354731.9
	25th, 50th, 75th	225793.0	225762.4	225799.7	225763.9	225822.9	225789.2	<b>1354731.0</b>
	10th, 75th, 90th	225804.0	225750.0	225808.0	225779.5	225821.1	225789.0	1354751.6
<b>BIC</b>	10th, 50th, 90th	227123.6	227090.8	227128.7	227096.9	227148.1	227115.7	1362703.8
	20th, 50th, 80th	227122.3	227091.1	227128.5	227093.5	227149.7	227116.9	1362702.0
	25th, 50th, 75th	227121.3	227090.7	227128.1	227092.3	227151.2	227117.5	<b>1362701.1</b>
	10th, 75th, 90th	227121.3	227090.7	227128.1	227092.3	227151.2	227117.5	1362701.1

Abbreviations: AIC, Akaike information criterion; BIC, Bayesian information criterion; PM<sub>2.5</sub>, particulate matter with an aerodynamic diameter  $\leq 2.5$   $\mu\text{m}$ ; BC, black carbon; OM, organic matter; SO<sub>4</sub><sup>2-</sup>, sulfate; NO<sub>3</sub><sup>-</sup>, nitrate; NH<sub>4</sub><sup>+</sup>, ammonium.

**Table S3.** Summary statistics of ambient air pollutants and meteorological factors during 2011–2018.

Environmental variables	Mean	Min	Percentiles			Max	IQR
			P <sub>25</sub>	P <sub>50</sub>	P <sub>75</sub>		
PM <sub>2.5</sub> mass, µg/m <sup>3</sup>	51.3 ± 21.7	16.26	34.20	46.68	65.51	110.97	31.3
PM <sub>2.5</sub> constituents							
BC, µg/m <sup>3</sup>	2.5 ± 0.9	0.80	1.86	2.37	3.05	5.13	1.2
OM, µg/m <sup>3</sup>	12.5 ± 4.8	4.19	8.92	11.54	15.64	25.35	6.7
SO <sub>4</sub> <sup>2-</sup> , µg/m <sup>3</sup>	9.7 ± 3.9	2.44	6.63	8.87	12.14	20.35	5.5
NO <sub>3</sub> <sup>-</sup> , µg/m <sup>3</sup>	11.0 ± 5.3	2.75	6.63	10.26	14.75	24.49	8.1
NH <sub>4</sub> <sup>+</sup> , µg/m <sup>3</sup>	7.7 ± 3.4	2.10	4.95	7.23	9.93	16.29	5.0
Meteorological factors							
Temperature, °C	24.4 ± 4.6	-16.56	22.45	25.86	27.27	31.31	4.8
Relative humidity, %	65.9 ± 10.1	36.96	57.36	67.74	74.73	81.97	17.4

Abbreviations: SD, standard deviation; IQR, interquartile range; PM<sub>2.5</sub>, particulate matter with an aerodynamic diameter ≤2.5 µm; BC, black carbon; OM, organic matter; NO<sub>3</sub><sup>-</sup>, nitrate; SO<sub>4</sub><sup>2-</sup>, sulfate; NH<sub>4</sub><sup>+</sup>, ammonium.

**Table S4** Baseline characteristics of individuals included in the analysis and those with fewer than two cognitive tests.

Variables	Number of tests		P-value
	0-1 (n=10,550)	vs 2-4 (n=13,507)	
<b>Sociodemographic characteristics, %</b>			
Age	60.1 (11.4)	56.6 (8.7)	<0.001
Gender			<0.001
Female	6127 (58.1)	6047 (44.8)	
Male	4423 (41.9)	7460 (55.2)	
Education attainment			<0.001
≤6	7830 (74.2)	7106 (52.6)	
>6	2720 (25.8)	6401 (47.4)	
Marital status			<0.001
Married	7806 (74.0)	11,761 (87.1)	
Single	2744 (26.0)	1746 (12.9)	
Employment Status			<0.001
Employed	6688 (63.4)	9817 (72.7)	
Unemployed	3862 (36.6)	3690 (27.3)	
Urbanicity			<0.001
Rural	6096 (57.8)	7340 (54.3)	
Urban	4454 (42.2)	6167 (45.7)	
<b>Behavioral factors, %</b>			
Smoking			<0.001
Yes	3543 (33.6)	5861 (43.4)	
No	7007 (66.4)	7646 (56.6)	
Drinking			<0.001
Yes	3134 (29.7)	4952 (36.7)	
No	7416 (70.3)	8555 (63.3)	
Social activity participation			<0.001
Yes	4870 (46.2)	5604 (41.5)	
No	5680 (53.8)	7903 (58.5)	
Intensity of physical activity			<0.001
High	3066 (29.1)	4528 (33.5)	
Medium	2772 (26.3)	4295 (31.8)	
Low	3128 (29.6)	3605 (26.7)	
Never	1584 (15.0)	1079 (8.0)	

**Table S4 (Continued)**

Sleep duration hours			<0.001
≤6	3402 (32.2)	3572 (26.4)	
(6, 8]	3929 (37.2)	6082 (45.0)	
>8	3219 (30.5)	3853 (28.5)	
<b>Household characteristics, %</b>			
Annual income, RMB			<0.001
≤6997	3180 (30.1)	2797 (20.7)	
(6997, 25,100]	2838 (26.9)	3445 (25.5)	
(25,100, 52,710]	2354 (22.3)	3494 (25.9)	
>52,710	2187 (20.6)	3771 (27.9)	
Cooking fuel type			<0.001
Clean	5033 (47.7)	7612 (56.4)	
Unclean	5517 (52.3)	5895 (43.6)	
<b>Health status, %</b>			
Prevalence of chronic diseases			0.028
Yes	7097 (67.3)	8797 (65.1)	
No	3453 (32.7)	4711 (34.9)	
Depression status			<0.001
Yes	4428 (42.0)	3895 (28.8)	
No	6122 (58.0)	9612 (71.2)	
Self-rated health status			<0.001
Poor	2137 (20.3)	1625 (12.0)	
Fair	3785 (35.9)	4703 (34.8)	
Good	4628 (43.9)	7179 (53.2)	