Supporting Information

Difference in ambient-personal exposure to $PM_{2.5}$ and its inflammatory effect in local residents in urban and peri-urban Beijing, China: Results of the AIRLESS project

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S1 Materials and Methods

S1.1 Measurement of health outcomes

Exhaled breath was collected by having each subject continuously exhale to a 4-L aluminum air-sampling bag at a controlled flow rate of 150 ± 20 mL s^{-1} until the bag reached its full volume. FeNO was measured with nitrogen oxides analyzer (Model 42i; Thermo Fisher Scientific, USA) within 4 hours after collecting the exhaled-breath sample, as described earlier. Fasting blood samples (fasting for at least 8 hours) were collected by a certified nurse and stored in EDTA-coated tubes. After collection, the blood samples were immediately sent for routine blood tests using an automated hematology system (XE-2100; Sysmex, Japan). C-reactive Protein (CRP) were measured with nephelometric method in the laboratory of Anzhen Hospital in central Beijing one month after the end of each campaign.

S1.2 Site information

Figure S2 shows the location of the urban and peri-urban ambient monitoring sites.

The urban site (GPS coordinates: 39.990, 116.313) is located in PKU campus on the roof of a six-floor building, namely the Peking University Urban Atmosphere Environment Monitoring Station (PKUERS). The site is located approximately 500 meters north to the 4th ring road of Beijing. Traffic is the major source around this site.

Urban participants were mainly living in the communities within 10 km around the site. Centralized heating infrastructure is covered in the urban area. Most of the urban participant (95.1%) used natural gas for cooking.

Peri-urban site (GPS coordinates: 40.167, 117.047) is located at Xibaidian Village, Pinggu District, in the north-eastern Beijing bordering the Tianjin municipality. The site is about 4 km north-west of the Pinggu Town centre and about 70 km northeast to the PKU site. There are several similar small villages (each with ~100-200 residents) and scattered agriculture land nearby. Most of the houses are one-story building in the villages, with relatively older ventilations such as chimneys, gaps around windows and doors. A new infrastructure was established prior to the intensive monitoring campaign, at the far north end of the village to avoid any significant emission sources. Instruments were deployed on the roof of a one-story building. A one-lane (single direction) road with low traffic volume is about 200-300 meters

north to the building sampling site.

All the peri-urban participants were living in the villages nearby within 6 km from the site. No centralized heating infrastructure was available during our winter monitoring campaign in 2016. Residents mainly use coal and biomass for heating and cooking at home.

S1.3 Statistical Analysis

The equation using linear mixed-effect model in this study was shown as below:

$$E(Y_{ij} \mid X_{ij}) = \alpha_0 + \beta_1 \cdot X_{ij} + f_{ns}(Temp_{24hij}, df) + f_{ns}(RH \\ \beta_4 \cdot Sex_{ij} + \beta_5 \cdot Education_{ij} + \beta_6 \cdot Income_{ij} + \beta_7 \\ + \beta_8 \cdot SecondSmoke_{ij} + \beta_9 \cdot Medication_{ij} + \varepsilon_{ij}$$

where *i* refers to a subject, *j* refers to a visit, X_{ij} and Y_{ij} are the level of exposure to a pollutant and the biomarker concentrations of subject *i* measured at visit *j*, f_{ns} is the natural spline function, df is the degree(s) of freedom. The degree of freedom applied for both ambient temperature and relative humidity was four, determined by reference to the Akaike information criterion.

All statistical analyses were performed using R Statistical Software (www.r-project.org; R version 3.4.1). A two–tailed P-value < 0.05 was considered statistically significant.

Supporting Information Figures

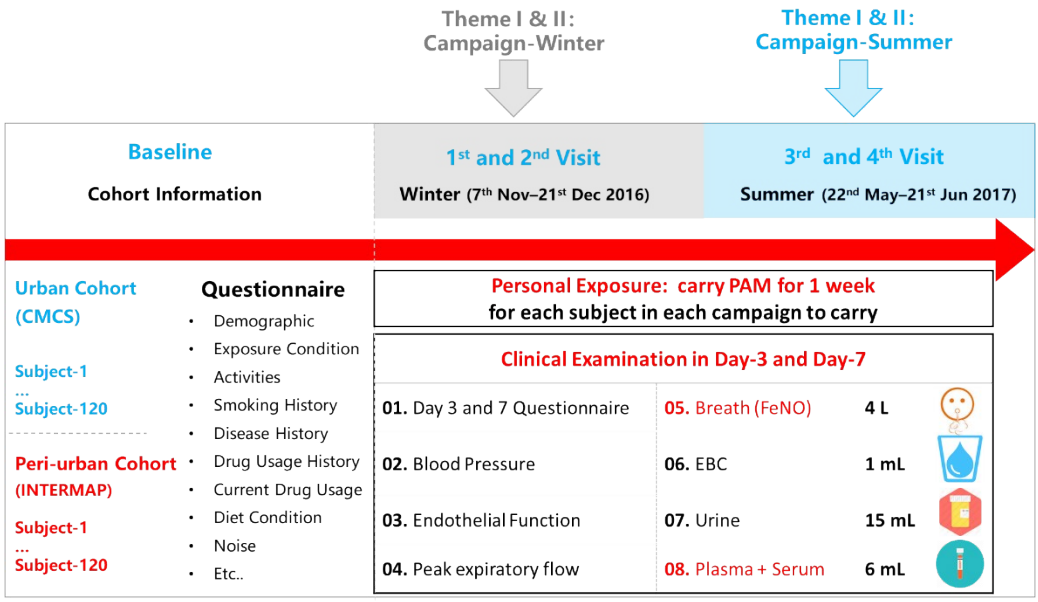

Fig S1. Schematic diagram of AIRLESS project.

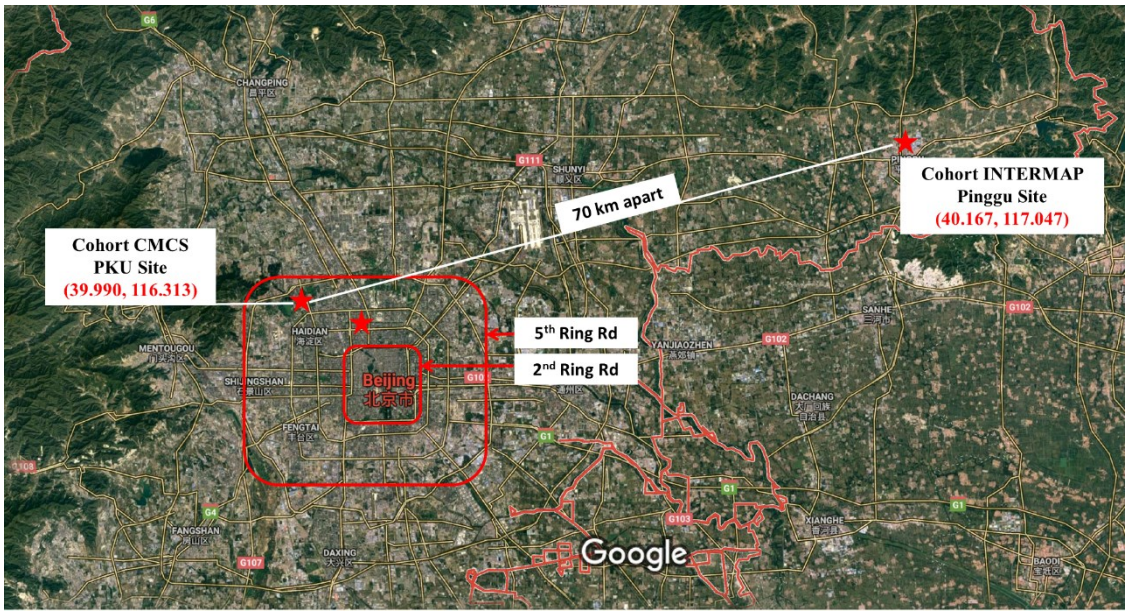

Fig S2. Locations of the two cohorts and three monitoring sites in urban and peri-urban Beijing. The figure is based on Google Map.

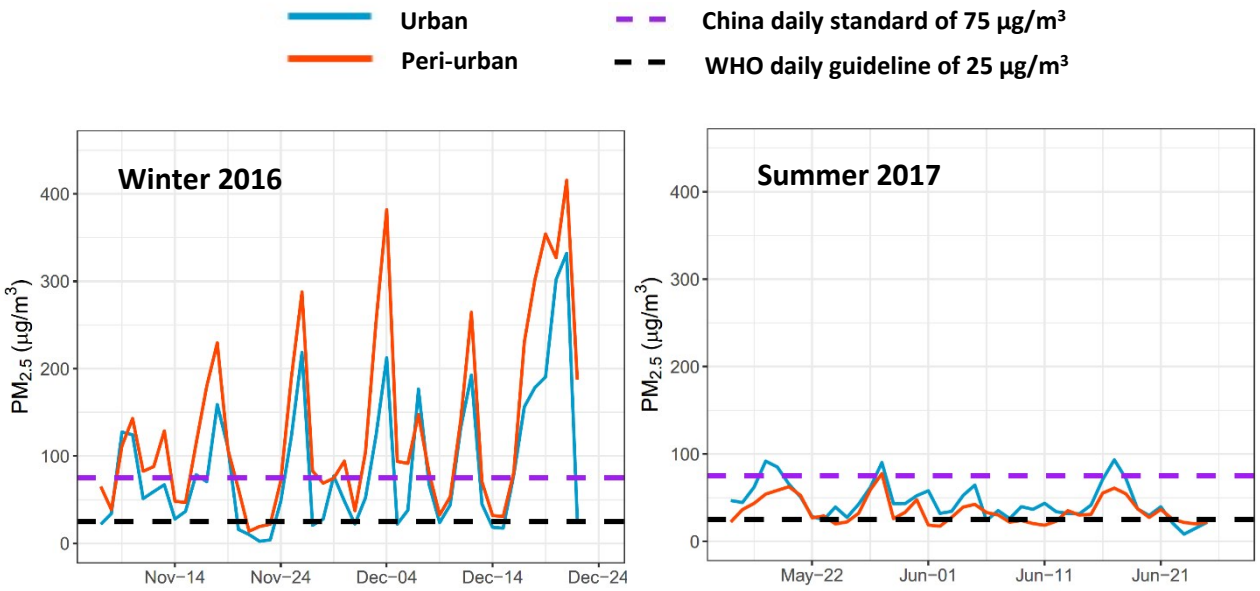

Fig S3. Seasonal and spatial trend of ambient $PM_{2.5}$ concentration during AIRLESS campaigns.

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Supporting Information Tables

Table S1, Summarized statistics of daily and weekly concentrations of personal and ambient $PM_{2.5}$ at the urban and peri-urban sites during the winter (Nov-Dec 2016) and summer (May-June 2017) campaigns

Exposure Metrics	Site	Season	Daily				Weekly			
			N	(Min, Max)	Mean (SD)	Meidan (IQR)	N	(Min, Max)	Mean (SD)	Meidan (IQR)
Personal $PM_{2.5}$	peri-urban	winter	877	(1.9, 512.8)	62.4 (60.8)	42.7 (61.5)	128	(22.8, 316.9)	63.0 (34.3)	57.0 (31.8)
	urban	winter	885	(0.3, 334.2)	34.2 (34.6)	24.7 (33.6)	123	(11.6, 180.3)	34.4 (20.2)	28.9 (15.0)
	peri-urban	summer	760	(5.8, 130.7)	34.7 (18.0)	30.4 (19.6)	116	(15.6, 87.4)	34.4 (12.1)	31.8 (11.1)
	urban	summer	726	(0.4, 173.4)	28.6 (16.4)	25.5 (17.4)	102	(10.4, 56.7)	28.6 (9.8)	26.6 (13.3)
Ambient $PM_{2.5}$	peri-urban	winter	958	(7.2, 345.4)	117.2 (96.7)	81.5 (166.9)	128	(79.2, 168.8)	117.3 (22.1)	109.9 (44.8)
	urban	winter	915	(0.0, 332.7)	85.4 (76.3)	64.5 (144.0)	123	(48.7, 174.0)	84.9 (28.9)	77.1 (27.0)
	peri-urban	summer	867	(13.4, 88.9)	34.3 (14.6)	31.6 (21.0)	116	(23.9, 45.7)	34.3 (6.2)	35.0 (10.6)
	urban	summer	780	(8.2, 93.8)	44.7 (17.4)	40.1 (20.8)	102	(23.0, 57.8)	44.8 (7.0)	45.5 (11.9)