**Table S1.** Chemical structures and groups of eighteen PAHs

| PAHs species | Abbreviation | Chemical structures | Molecular weight | Rings |
|---|---|---|---|---|
| Naphthalene | Nap | $C_{10}H_8$ | 128 | 2 |
| Acenaphthylene | Acy | $C_{12}H_8$ | 152 | 3 |
| Acenaphthene | Ace | $C_{12}H_{10}$ | 154 | 3 |
| Fluorene | Flu | $C_{13}H_{10}$ | 166 | 3 |
| Phenanthrene | Phe | $C_{14}H_{10}$ | 178 | 3 |
| Anthracene | Ant | $C_{14}H_{10}$ | 178 | 3 |
| Fluoranthene | Fln | $C_{16}H_{10}$ | 202 | 4 |
| Pyrene | Pyr | $C_{16}H_{10}$ | 202 | 4 |
| Chrysene | Chr | $C_{18}H_{12}$ | 228 | 4 |
| Benz[a]anthracene | BaA | $C_{18}H_{12}$ | 228 | 4 |
| Benz[b]fluoranthene | BbF | $C_{20}H_{12}$ | 252 | 5 |
| Benz[k]fluoranthene | BkF | $C_{20}H_{12}$ | 252 | 5 |
| Benzo[j]fluoranthene | BjF | $C_{20}H_{12}$ | 252 | 5 |
| Benzo[a]pyrene | BaP | $C_{20}H_{12}$ | 252 | 5 |
| Benzo[e]pyrene | BeP | $C_{20}H_{12}$ | 252 | 5 |
| Indeno[1,2,3-cd]pyrene | InD | $C_{22}H_{12}$ | 276 | 6 |
| Benzo[g,h,i]-perylene | BghiP | $C_{22}H_{12}$ | 276 | 6 |
| Dibenzo[a,h]anthracene | DbA | $C_{22}H_{14}$ | 278 | 6 |

**Table S2.** Mann-Whitney U test of $PM_{2.5}$, $\sum_{18}$PAHs and BaP in non-heating and heating periods

| Variables | Non-heating period | Heating period | *p* value |
|---|---|---|---|
| $PM_{2.5}$ | 79 (115) | 106 (175) | 0.091 |
| $\sum_{18}$PAHs | 185 (126) | 282 (193) | 0.003 |
| BaP | 3.64 (6.20) | 60.4 (31.5) | < 0.001 |
| Temperature (°C) | 4.95 (12.4) | -1.25 (3.55) | 0.023 |
| Relative humidity (%) | 66 (29.5) | 66 (35.5) | 0.862 |
| Wind speed (m/s) | 7.5 (2.75) | 6.95 (4.33) | 0.659 |

$p < 0.05$ for statistical difference.

**Table S3.** Spearman correlation of $\sum_{18}$PAHs and meteorological factors in samping periods

| Variables | Temperature | Relative humidity (%) | Wind speed | $\sum_{18}$PAHs |
|---|---|---|---|---|
| Temperature | 1 | -0.033 | -0.015 | -0.428** |
| Relative humidity (%) |  | 1 | -0.695** | 0.255 |
| wind speed |  |  | 1 | 0.113 |
| $\sum_{18}$PAHs |  |  |  | 1 |

*** Correlation is significant at the 0.01 level (two-tailed)*

**Table S4.** Diagnostic ratios of $PM_{2.5}$-bound PAHs and their corresponding values in present study

| Diagnostic ratio | Non-heating period | Heating period | Ratio range | Sources | References |
|---|---|---|---|---|---|
| Ant/(Ant+Phe) | 0.28 | 0.43 | < 0.1 | Petroleum | [49] |
|  |  |  | > 0.1 | Combustion |  |
| Flu/(Flu+Pyr) | 0.55 | 0.59 | < 0.4 | Petroleum input | [49,50] |
|  |  |  | 0.4-0.5 | Liquid fossil fuel combustion |  |
|  |  |  | > 0.5 | Grass, wood and coal combustion |  |
| BaA/(BaA+Chr) | 0.58 | 0.57 | > 0.35 | Petroleum combustion | [6,49] |
|  |  |  | 0.2-0.35 | Grass, wood and coal combustion |  |
|  |  |  | < 0.2 | Petroleum |  |
| InD/(InD+BghiP) | 0.21 | 0.15 | < 0.2 | Petroleum sources | [6] |
|  |  |  | 0.2-0.5 | Petroleum combustion |  |
|  |  |  | > 0.5 | Grass, wood and coal combustion |  |

**Table S5.** Average BaPeq concentrations of $PM_{2.5}$-bound PAHs ($ng/m^3$)

| PAHs species | Toxic equivalency factor (TEF) | BaPeq concentration ($ng/m^3$) | |
|---|---|---|---|
| | | Non-heating period | Heating period |
| Nap | 0.001 | 0.014 | 0.033 |
| Acy | 0.001 | 0.024 | 0.043 |
| Ace | 0.001 | 0.006 | 0.012 |
| Flu | 0.001 | 0.001 | 0.003 |
| Phe | 0.001 | 0.005 | 0.005 |
| Ant | 0.01 | 0.045 | 0.035 |
| Fln | 0.001 | 0.005 | 0.017 |
| Pyr | 0.001 | 0.004 | 0.012 |
| Chr | 0.01 | 0.021 | 0.076 |
| BaA | 0.1 | 0.316 | 0.985 |
| BbF | 0.1 | 0.683 | 2.667 |
| BkF | 0.1 | 2.548 | 1.655 |
| BjF | 0.1 | 1.286 | 3.383 |
| BaP | 1 | 18.900 | 61.560 |
| BeP | 0.01 | 0.227 | 0.069 |
| DbA | 1 | 0.810 | 0.375 |
| BghiP | 0.01 | 0.517 | 0.239 |
| InD | 0.1 | 1.797 | 0.205 |
| Total | | 27.2 | 71.4 |
| BaP/Total (%) | | 69.5 | 85.3 |
| Carcinogenicity index | | $2.99\times10^{-5}$ | $7.85\times10^{-5}$ |