Supplementary Material

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Table S1. Information on sample collection from different cooking styles.

Cooking styles	Number of Samples	Edible oil types	Fuel Types	Oil consumption (kg/h)	Types of oil fume purification equipment	Average exhaust volume (m^3/h)	Major foods served	Major ingredient category	Features
BB	6	Soybean Oil and Blending oil	Liquefied Gas	8.35	Electrostatic fume purifier	4667	Lamb chops, pork skewers and various vegetables	Cumin, paprika, oyster and barbecue sauce	High temperature and large amount of oil
BC	8	Soybean Oil	Natural Gas	2.11	Electrostatic fume purifier	6000	Roast duck, fish, chicken and vegetables	Sweet sauce, cooking wine, sugar, salt	Slipped, exploded and roasted
CC	10	Soybean Oil	Natural Gas, Liquefied Gas	2.78	Electrostatic fume purifier	9600	various meats and vegetables	Oyster sauce, salt, soy sauce, ginger,	Complex cooking styles
CFF	8	Soybean Oil and Blending oil	Natural Gas, Liquefied Gas	3.12	Electrostatic fume purifier	4000	Potato, cabbage and meats skewers	Oyster sauce, salt, soy sauce	Stir-frying and deep-frying
CT	4	Soybean Oil	Natural Gas	2.78	Composite electrostatic fume purifier	6500	Pork, potato, tomato, wax gourd	Chicken essence, soy sauce, salt	Centralized cooking with large cooking quantities
GC	6	Soybean Oil	Natural Gas	2.33	Electrostatic fume purifier	7000	Fish, shrimp, meats soups and vegetables	Bay leaf, verum, cooking wine and salt	Strict requirements on fire and oil temperature

NC	8	Soybean Oil	Liquefied Gas	3.23	Electrostatic fume purifier	4000	Eggplant, chicken, green bean and other vegetables	Green onion, ginger, garlic, salt	Grilling, deep-frying, roasting
ND	10	Soybean Oil	Natural Gas, Liquefied Gas	3.26	Electrostatic fume purifier	6800	Various noodles and vegetables	Vinegar, pepper, salt, scallions, ginger	Soup type, involving stir-fry dishes
SHC	10	Soybean Oil	Natural Gas, Eco-friendly oil	4.23	Electrostatic fume purifier	4500	Tofu, tomato, onion, pork, fish and other vegetables	Green onion, pepper, salt, ginger, garlic, cooking wine	Numbness, spicy, aromatic and fresh
WFF	4	Soybean Oil	Liquefied Gas, Electricity	3.56	Electrostatic fume purifier	4000	Chicken, beef, broccoli, bread and various vegetables	Cumin and various spice	Mostly fried
ZC	4	Soybean Oil	Natural Gas, Eco-friendly oil	3.12	Electrostatic fume purifier	1950	Fish, chicken ,Chinese yam, Baby cabbage	Vinegar, salt, sugar, ginger and garlic	Stir-frying, braising and steaming

Table S2. Information on kitchen exhaust equipment for different cooking styles.

Cooking styles	Type of exhaust equipment	Average exhaust rate (m^3/h)
BB	Integrated exhaust and oil fume purification machin	4667
BC	Ceiling mounted exhaust fan	2000
CC	Centrifugal exhaust fan	1500
CFF	Axial flow exhaust fan	1200
CT	Ceiling mounted exhaust fan	1920
GC	Ceiling mounted exhaust fan	1800
NC	Ceiling mounted exhaust fan	1200
ND	Ceiling mounted exhaust fan	1200
SHC	Centrifugal exhaust fan	2100
WFF	Window wall exhaust fan	800
ZC	Cabinet exhaust fan	2000

Table S3. Parameter settings related to the testing of PAHs using gas chromatography triple quadrupole mass spectrometry (GC-MS).

PAHs	Abbreviation	CAS #	Quantification transition (m/z)	Collision energy (V)	Confirmation transition (m/z)	Collision energy (V)
Naphthalene	Nap	91-20-3	128 > 102	20	128 > 78	25
Acenaphthylene	Acy	208-96-8	152 > 150	35	152 > 151	25
Acenaphthene	Ace	83-32-9	153 > 152	25	154 > 153	20
Fluorene	Fle	86-73-7	166 > 165	25	166 > 115	45
Phenanthrene	Phe	85-01-8	178 > 176	35	178 > 152	30
Anthracene	Ant	120-12-7	178 > 176	35	178 > 152	30
Fluoranthene	Flu	206-44-0	202 > 200	45	202 > 201	30
Pyrene	Pyr	129-00-0	202 > 200	45	202 > 201	30
Benzo[a]anthracene	BaA	56-55-3	228 > 226	40	226 > 224	45
Chrysene	Chr	218-01-9	228 > 226	40	226 > 224	45
Benzo[b]fluoranthene	BbF	205-99-2	252 > 250	45	252 > 225	45
Benzo[k]fluoranthene	BkF	207-08-9	252 > 250	45	252 > 225	45
Benzo[a]pyrene	BaP	50-32-8	252 > 250	45	252 > 225	45
Indeno[1,2,3-cd]pyrene	IcdP	193-39-5	276 > 274	40	276 > 275	35
Dibenzo[a,h]anthracene	DBahA	53-70-3	302 > 300	45	300 > 298	45
Benzo[ghi]perylene	BghiP	191-24-2	276 > 274	40	276 > 275	35
Naphthalene-d8	Nap-d8	1146-65-2	136 > 134	20	136 > 108	20
Acenaphthylene-d8	Acy-d8	93951-97-4	160 > 132	30	160 > 108	30
Phenanthrene-d10	Phe-d10	1517-22-2	188 > 184	30	188 > 160	30
Fluoranthene-d10	Flu-d10	93951-69-0	212 > 208	25	212 > 160	30
Benzo[a]anthracene-d12	BaA-d12	1718-53-2	240 > 238	30	240 > 236	30
Chrysene-d12	Chr-d12	1719-03-5	240 > 238	30	240 > 236	30
Benzo[a]pyrene-d12	BaP-d12	63466-71-7	264 > 260	40	264 > 234	40
Dibenzo[a,h]anthracene-d14	DBahA-d14	13250-98-1	292 > 288	50	288 > 284	50
Benzo[ghi]perylene-d12	BghiP-d12	93951-66- 7	288 > 282	50	288 > 284	50
Acenaphthene-d10	Ace-d10	15067-26-2	164 > 162	30	160 > 132	30
Pyrene-d10	Pyr-d10	1718-52-1	212 > 210	25	208 > 156	30
Benzo[e]pyrene-d12	BeP-d12	205440-82-0	264>260	50	264>258	45

Table S4. The recovery rate, method detection limit (MDL), and toxicity equivalent factor (TEF) of targeted PAHs in this study.

PAHs	Recovery (%)	MDLs (ng/m^3)	TEFs
Nap	76.2	0.038	0.001
Ace	65.3	0.021	0.001
Acy	93.5	0.028	0.001
Fle	98.8	0.022	0.001
Phe	103.4	0.106	0.001
Ant	77.8	0.028	0.01
Flu	86.2	0.048	0.001
Pyr	96.0	0.020	0.001
BaA	105.6	0.075	0.1
Chr	85.3	0.022	0.01
BbF	90.2	0.032	0.1
BkF	93.2	0.057	0.1
BaP	96.5	0.076	1
IcdP	83.1	0.121	0.1
BghiP	91.4	0.092	0.1
DBahA	74.7	0.220	1

Table S5. Parameters used in the incremental lifetime cancer risk assessment.

Definition	units	Children		Adolescence		Adult		Old age		References
		Male	Female	Male	Female	Male	Female	Male	Female	
Age	a	⩽ 5[1]	⩽ 5[1]	6~17[2]	6~17[2]	18~59[3]	18~59[3]	≥ 60[3]	≥ 60[3]	[1-3]
Body weight (BW)	kg	12.8[1]	12.2[1]	46.2[2]	41.4[2]	70.5[3]	62.1[3]	65.9[3]	57.8[3]	[1-3]
Exposure frequency (EF)	min/d d/year	3.5[1] 0.89[1]	3.7[1] 0.93[1]	12.5[2] 3.17[2]	14.0[2] 3.55[2]	104.0[4] 26.36[4]	105.0[4] 26.61[4]	104.0[4] 26.36[4]	105.0[4] 26.61[4]	[1-2, 4]
Exposure duration (ED)	year	5	5	6	6	24	24	24	24	[5]
Inhalation rate (IR_{inh})	m^3/d	6.7[1]	6.2[1]	14.0[2]	11.3[2]	19.0[3]	15.2[3]	14.1[3]	12.8[3]	[1-3]
Ingestion rate (IR_{ing})	mg/d	76[1]	68[1]	104[2]	87[2]	50[3]	50[3]	50[3]	50[3]	[1-3]
Dermal surface exposure (SA)	cm^2/d	2800	2800	2800	2800	5700	5700	5700	5700	[5]
Dermal adherence factor (AF)	mg/cm^2	0.04	0.04	0.04	0.04	0.02	0.02	0.02	0.02	[6]

Note: BW, IR_{inh}, IR_{ing} and EF are the mean values, and parameters from the North China region are preferred.

Table S6. The parameters used in the analysis of Monte-Carlo simulation model.

Parameters	Distribution	Unit	Children		Adolescence		Adult		Old age		References
			Male	Female	Male	Female	Male	Female	Male	Female	
BW	Normal	kg	12.8± 4.6[1]	12.2± 4.6[1]	46.2± 14.9[2]	41.4± 12.7[2]	70.5± 0.2[3]	62.1± 2.4[3]	65.9± 1.7[3]	57.8± 4.3[3]	[1-3]
AT	Point	d	25550	25550	25550	25550	25550	25550	25550	25550	[7]
EF	Point	d/year	0.89[1]	0.93[1]	3.17[2]	3.55[2]	26.36[4]	26.61[4]	26.36[4]	26.61[4]	[1-2, 4]
ED	Uniform	years	0 – 5	0 – 5	0 – 6[5]	0 – 6[5]	0 – 24[5]	0 – 24[5]	0 – 24[5]	0 – 24[5]	[5]
IR_{ing}	Point	mg/d	76[1]	68[1]	104[2]	87[2]	50[3]	50[3]	50[3]	50[3]	[1-3]
IR_{inh}	Lognormal	m^3/d	6.7±1.8[1]	6.2±1.7[1]	14.0±2.4[2]	11.3±1.2[2]	19.0±0.3[3]	15.2±0.1[3]	14.1±1.3[3]	12.8±1.1[3]	[1-3]
CSF_{ing}	Lognormal	$(mg/kg/d)^{-1}$	7.30 ± 1.15	7.30 ± 1.15	7.30 ± 1.15	7.30 ± 1.15	7.30 ± 1.15	7.30 ± 1.15	7.30 ± 1.15	7.30 ± 1.15	[8]
CSF_{inh}	Point	$(mg/kg/d)^{-1}$	3.14 ± 1.80	3.14 ± 1.80	3.14 ± 1.80	3.14 ± 1.80	3.14 ± 1.80	3.14 ± 1.80	3.14 ± 1.80	3.14 ± 1.80	[8]
CSF_{der}	Point	$(mg/kg/d)^{-1}$	25	25	25	25	25	25	25	25	[8]
ABS	Lognormal	unitless	0.13 ± 1.26	0.13 ± 1.26	0.13 ± 1.26	0.13 ± 1.26	0.13 ± 1.26	0.13 ± 1.26	0.13 ± 1.26	0.13 ± 1.26	[5]
SA	Point	m^2/d	2800	2800	2800	2800	5700	5700	5700	5700	[5]
AF	Lognormal	mg/cm^2	0.04 ± 3.41	0.04 ± 3.41	0.04 ± 3.41	0.04 ± 3.41	0.02 ± 2.67	0.02 ± 2.67	0.02 ± 2.67	0.02 ± 2.67	[7]
PEF	Point	$m^3/\mu g$	1.36×10^9	1.36×10^9	1.36×10^9	1.36×10^9	1.36×10^9	1.36×10^9	1.36×10^9	1.36×10^9	[8]

Table S7. Percentage contribution to carcinogenicity by each PAH in different cooking styles (%).

Cooking styles	Ant	Ace	BaA	BaP	BbF	BghiP	BkF	Chr	DBahA	Fle	Flu	IcdP	Nap	Phe	Pyr	Acy
BB	7.50	0.03	7.74	18.41	3.59	1.61	4.94	0.44	35.55	0.23	0.29	18.50	0.26	0.78	0.11	0.02
BC	5.78	0.41	3.72	0.00	0.77	1.58	14.52	0.41	47.21	0.18	0.02	24.09	0.98	0.31	0.02	0.01
CC	1.14	0.37	2.10	37.08	3.18	2.40	2.89	0.62	25.32	0.36	0.03	24.00	0.27	0.22	0.01	0.01
CFF	2.98	0.57	2.39	31.40	3.32	0.52	10.15	0.49	39.59	0.27	0.02	7.58	0.32	0.34	0.01	0.03
CT	1.60	0.29	7.19	21.95	4.85	0.82	7.92	0.50	43.70	0.11	0.11	10.46	0.14	0.28	0.07	0.01
GC	1.24	0.11	3.00	8.61	5.93	1.26	6.02	0.46	48.70	0.11	0.02	24.02	0.12	0.34	0.01	0.04
NC	0.02	0.07	3.06	14.41	13.34	0.62	9.90	0.21	50.74	0.01	0.01	7.31	0.21	0.03	0.03	0.01
ND	5.09	0.04	7.08	15.41	2.24	1.74	4.52	1.28	38.80	0.15	0.09	21.93	0.88	0.69	0.04	0.03
SHC	1.80	0.01	3.73	26.65	0.44	1.20	5.52	0.70	45.93	0.13	0.10	12.58	0.74	0.30	0.10	0.05
WFF	0.79	0.01	12.82	26.81	0.76	0.00	1.67	1.73	51.39	0.01	0.02	3.60	0.25	0.11	0.00	0.01
ZC	5.67	0.07	0.87	20.52	10.93	0.00	6.55	0.75	38.92	0.07	0.31	14.19	0.24	0.79	0.07	0.06

Table S8. The incremental lifetime cancer risk (ILCR) at different cooking styles of $PM_{2.5}$-bound PAHs under different ages and genders.

Cooking styles	exposure types	Children		Adolescence		Adult		Old age	
		Male	Female	Male	Female	Male	Female	Male	Female
BB	$ILCR_{ing}$	1.59E-07	1.47E-07	1.45E-07	1.44E-07	1.67E-06	1.84E-06	1.75E-06	1.93E-06
	$ILCR_{inh}$	6.55E-12	6.50E-12	6.41E-12	6.03E-12	2.01E-10	1.77E-10	1.87E-10	1.56E-10
	$ILCR_{der}$	7.05E-08	8.34E-08	6.97E-08	8.26E-08	1.70E-06	1.87E-06	1.78E-06	1.96E-06
	$ILCR_{total}$	2.29E-07	2.30E-07	2.14E-07	2.27E-07	3.37E-06	3.70E-06	3.53E-06	3.88E-06
BC	$ILCR_{ing}$	5.79E-08	5.35E-08	5.27E-08	5.25E-08	6.09E-07	6.69E-07	6.37E-07	7.02E-07
	$ILCR_{inh}$	2.39E-12	2.37E-12	2.33E-12	2.19E-12	7.32E-11	6.43E-11	6.81E-11	5.68E-11
	$ILCR_{der}$	2.57E-08	3.04E-08	2.54E-08	3.01E-08	6.18E-07	6.79E-07	6.47E-07	7.12E-07
	$ILCR_{total}$	8.35E-08	8.39E-08	7.81E-08	8.26E-08	1.23E-06	1.35E-06	1.28E-06	1.41E-06
CC	$ILCR_{ing}$	1.47E-07	1.36E-07	1.34E-07	1.34E-07	1.55E-06	1.70E-06	1.62E-06	1.79E-06
	$ILCR_{inh}$	6.08E-12	6.03E-12	5.95E-12	5.59E-12	1.86E-10	1.64E-10	1.73E-10	1.45E-10
	$ILCR_{der}$	6.53E-08	7.74E-08	6.47E-08	7.66E-08	1.57E-06	1.73E-06	1.65E-06	1.81E-06
	$ILCR_{total}$	2.13E-07	2.14E-07	1.99E-07	2.10E-07	3.13E-06	3.43E-06	3.27E-06	3.60E-06
CFF	$ILCR_{ing}$	1.01E-07	9.36E-08	9.22E-08	9.18E-08	1.07E-06	1.17E-06	1.11E-06	1.23E-06
	$ILCR_{inh}$	4.17E-12	4.14E-12	4.08E-12	3.84E-12	1.28E-10	1.13E-10	1.19E-10	9.94E-11
	$ILCR_{der}$	4.49E-08	5.31E-08	4.44E-08	5.26E-08	1.08E-06	1.19E-06	1.13E-06	1.25E-06
	$ILCR_{total}$	1.46E-07	1.47E-07	1.37E-07	1.44E-07	2.15E-06	2.36E-06	2.25E-06	2.47E-06
CT	$ILCR_{ing}$	8.93E-08	8.25E-08	8.13E-08	8.10E-08	9.39E-07	1.03E-06	9.82E-07	1.08E-06
	$ILCR_{inh}$	3.68E-12	3.65E-12	3.60E-12	3.38E-12	1.13E-10	9.92E-11	1.05E-10	8.76E-11
	$ILCR_{der}$	3.96E-08	4.68E-08	3.92E-08	4.64E-08	9.53E-07	1.05E-06	9.97E-07	1.10E-06
	$ILCR_{total}$	1.29E-07	1.30E-07	1.20E-07	1.27E-07	1.89E-06	2.08E-06	1.98E-06	2.18E-06

GC	$ILCR_{ing}$	8.47E-08	7.83E-08	7.72E-08	7.69E-08	8.92E-07	9.80E-07	9.33E-07	1.03E-06
	$ILCR_{inh}$	3.49E-12	3.47E-12	3.42E-12	3.21E-12	1.07E-10	9.42E-11	9.97E-11	8.32E-11
	$ILCR_{der}$	3.76E-08	4.45E-08	3.72E-08	4.41E-08	9.05E-07	9.94E-07	9.47E-07	1.04E-06
	$ILCR_{total}$	1.22E-07	1.23E-07	1.14E-07	1.21E-07	1.80E-06	1.97E-06	1.88E-06	2.07E-06
NC	$ILCR_{ing}$	8.55E-08	7.91E-08	7.79E-08	7.76E-08	9.00E-07	9.89E-07	9.41E-07	1.04E-06
	$ILCR_{inh}$	3.53E-12	3.50E-12	3.45E-12	3.24E-12	1.08E-10	9.51E-11	1.01E-10	8.40E-11
	$ILCR_{der}$	3.79E-08	4.49E-08	3.75E-08	4.45E-08	9.14E-07	1.00E-06	9.56E-07	1.05E-06
	$ILCR_{total}$	1.23E-07	1.24E-07	1.15E-07	1.22E-07	1.81E-06	1.99E-06	1.90E-06	2.09E-06
ND	$ILCR_{ing}$	6.34E-08	5.86E-08	5.77E-08	5.75E-08	6.67E-07	7.33E-07	6.98E-07	7.69E-07
	$ILCR_{inh}$	2.61E-12	2.59E-12	2.56E-12	2.40E-12	8.02E-11	7.05E-11	7.46E-11	6.23E-11
	$ILCR_{der}$	2.81E-08	3.33E-08	2.78E-08	3.30E-08	6.77E-07	7.44E-07	7.09E-07	7.81E-07
	$ILCR_{total}$	9.15E-08	9.16E-08	8.56E-08	9.05E-08	1.34E-06	1.48E-06	1.41E-06	1.55E-06
SHC	$ILCR_{ing}$	1.46E-07	1.35E-07	1.33E-07	1.32E-07	1.53E-06	1.68E-06	1.60E-06	1.77E-06
	$ILCR_{inh}$	6.01E-12	5.96E-12	5.88E-12	5.53E-12	1.84E-10	1.62E-10	1.71E-10	1.43E-10
	$ILCR_{der}$	6.46E-08	7.65E-08	6.39E-08	7.58E-08	1.56E-06	1.71E-06	1.63E-06	1.79E-06
	$ILCR_{total}$	2.10E-07	2.11E-07	1.97E-07	2.08E-07	3.09E-06	3.39E-06	3.23E-06	3.56E-06
WFF	$ILCR_{ing}$	1.31E-07	1.21E-07	1.19E-07	1.18E-07	1.37E-06	1.51E-06	1.44E-06	1.58E-06
	$ILCR_{inh}$	5.38E-12	5.34E-12	5.27E-12	4.95E-12	1.65E-10	1.45E-10	1.54E-10	1.28E-10
	$ILCR_{der}$	5.79E-08	6.85E-08	5.73E-08	6.79E-08	1.39E-06	1.53E-06	1.46E-06	1.61E-06
	$ILCR_{total}$	1.88E-07	1.89E-07	1.76E-07	1.86E-07	2.77E-06	3.04E-06	2.90E-06	3.19E-06
ZC	$ILCR_{ing}$	7.70E-08	7.12E-08	7.01E-08	6.99E-08	8.11E-07	8.90E-07	8.48E-07	9.34E-07
	$ILCR_{inh}$	3.18E-12	3.15E-12	3.11E-12	2.92E-12	9.74E-11	8.56E-11	9.06E-11	7.56E-11
	$ILCR_{der}$	3.41E-08	4.04E-08	3.38E-08	4.00E-08	8.23E-07	9.04E-07	8.61E-07	9.48E-07
	$ILCR_{total}$	1.11E-07	1.12E-07	1.04E-07	1.10E-07	1.63E-06	1.79E-06	1.71E-06	1.88E-06

Table S9. The respiratory deposition doses in three regions of different ages and genders of different cooking styles.

Cooking styles	RDD_{UA} (ng/h)		RDD_{TB} (ng/h)		RDD_{AL} (ng/h)	
	Children	**Adults**	**Children**	**Adults**	**Children**	**Adults**
BB	92.59	231.48	8.17	20.42	14.54	36.34
BC	34.81	87.03	3.07	7.68	5.47	13.66
CC	57.92	144.81	5.11	12.77	9.09	22.73
CFF	43.42	108.55	3.83	9.58	6.82	17.04
CT	28.18	70.45	2.49	6.22	4.42	11.06
GC	24.04	60.10	2.12	5.30	3.77	9.44
NC	14.01	35.02	1.24	3.09	2.20	5.50
ND	37.64	94.11	3.32	8.30	5.91	14.77
SHC	58.08	145.19	5.12	12.81	9.12	22.79
WFF	23.03	57.59	2.03	5.08	3.62	9.04
ZC	38.34	95.84	3.38	8.45	6.02	15.05

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