

Supplementary Information (SI)

This supplementary information includes:

Equation (S1) to (S5)

Table S1 to S4

The respiratory deposition doses (RDDs) can be evaluated by:

$$RDD = DF_i \times (VT \times f) \times PM_i \quad (S1)$$

where VT is a tidal volume ($\text{m}^3 \text{ breathe}^{-1}$), f is the typical breath frequency (breath min^{-1}), PM_i is the mass concentration of a size fraction I , and DF_{ij} is deposition fraction of a size fraction i and region j , e.g., head airways (DF_{HD}), tracheobronchial (DF_{TB}) and alveolar (DF_{AL}) regions.

The deposition fraction for the head airways region (DF_{HD}) was calculated as follows:

$$DF_{HD} = IF \left(\frac{1}{1 + \exp(6.84 + 1.183 \ln d_p)} + \frac{1}{1 + \exp(0.924 - 1.885 \ln d_p)} \right) \quad (S2)$$

where d_p is the particle size in μm , while IF is the inhalable fraction calculated by:

$$IF = 1 - 0.5 \left(1 - \frac{1}{1 + 0.00076 d_p^{2.8}} \right) \quad (S3)$$

The deposition fraction for the tracheobronchial region, DF_{TB} , was determined by:

$$DF_{TB} = \left(\frac{0.00352}{d_p} \right) \left[\exp(-0.234(\ln d_p + 3.40)^2) + 63.9 \exp(-0.819(\ln d_p - 1.61)^2) \right] \quad (S4)$$

The deposition fraction for the alveolar region, DF_{AL} , was estimated by:

$$DF_{AL} = \left(\frac{0.0155}{d_p} \right) \left[\exp(-0.416(\ln d_p + 2.84)^2) + 19.11 \exp(-0.482(\ln d_p - 1.362)^2) \right] \quad (S5)$$

Table S1. Description of schoolchildren participants for personal exposure measurement.

Student's origin	sex		home position			house occupant (people)		cooking duration/day (hour)				Smoking's at home		way to school	
	boy	girl	near roadside	small road	housing estate	3-4	5-8	<1	1-2	3-4	≥5	yes	no	car	motor- cycle
Urban schools															
U1	3	2	-	2	3	3	2	-	1	2	2	4	1	3	2
U2	1	7	-	8	-	5	3	1	3	2	2	4	4	-	8
U3	2	4	2	4	-	3	3	1	3	2	-	4	2	-	6
Total	6	13	2	14	3	11	8	2	7	6	4	12	7	3	16
Suburban schools															
SU1	3	5	1	6	1	7	1	-	-	4	4	5	3	-	8
SU2	-	7	1	1	5	4	3	-	1	2	4	6	1	-	7
Total	3	12	2	7	6	11	4	0	1	6	8	11	4	0	15
TOTAL	9	25	4	21	9	22	12	2	8	12	12	23	11	3	31

Table S2. Types of statistical tests used for data analyses.

Types of statistical			
No	analysis		description
1	Parametric tests	ANOVA	Comparison of schoolchildren's exposure to $PM_{<0.1}$, $PM_{0.1-0.4}$, and $PM_{0.4-1.0}$ based on their school origin and between their area of living (urban and suburban).
		Post-hoc test	Comparison details for the most significantly different of schoolchildren's exposure to $PM_{<0.1}$ and $PM_{0.1-0.4}$ following ANOVA result test based on their school origin.
2	Non-parametric tests	Kruskal-Wallis test	Comparison of schoolchildren's exposure to $PM_{1.0-2.5}$ based on their school origin.
		Mann-Whitney test	Comparison of schoolchildren's exposure to $PM_{1.0-2.5}$ between participants in urban schools and participants in suburban schools.

Table S3. General Characteristics of schoolchildren from five observed schools.

Characteristics	U1		U2		U3		SU1		SU2		Total		
	boys	Girls	boys	Girls	boys	Girls	boys	girls	boys	girls	boys	girls	all
7th grade (12-13 years old)	9	15	23	35	14	34	26	45	12	23	84 35.6%	152 64.4%	236 32.8%
8th grade (13-14 years old)	20	39	25	55	77	80	26	48	15	25	163 39.8%	247 60.2%	410 57.0%
9th grade (14-15 years old)	-	5	9	9	15	18	4	7	1	5	29 39.7%	44 60.3%	73 10.2%
	29 88 (12.2%)	59	57 156 (21.7%)	99	106 238 (33.1%)	132	56 156 (21.7%)	100	28 81 (11.3%)	53	276 38.4%	443 61.6%	719 children
LIVING CONDITION													
House location													
near roadside	11	20	3	13	11	13	9	17	4	4	38 36.2%	67 63.8%	105 14.6%
small road	11	26	51	79	61	81	31	60	11	13	165 43.2%	259 67.8%	424 59.0%
housing estate	7	13	3	7	34	38	16	23	13	36	73 38.4%	117 61.6%	190 26.4%
Family members													
3 - 5 ORANG	21	40	40	67	76	93	46	64	24	36	207 40.8%	300 59.2%	507 70.5%
5 - 8 ORANG	6	16	14	29	23	35	10	31	4	17	57 30.8%	128 69.2%	185 25.7%
> 8 ORANG	2	3	3	3	7	4	-	5	-	-	12 44.4%	15 55.6%	27 3.8%
Smoking status													
Yes	15	38	39	68	58	56	38	63	20	38	170 39.3%	263 60.7%	433 60.2%
No	14	21	18	31	48	50	18	37	8	15	106 40.8%	154 59.2%	260 36.2%
Cooking hours/day													
2-3 hours	25	48	50	89	101	121	54	97	27	49	257 38.9%	404 61.1%	661 91.9%
4-5 hours	4	10	4	10	3	10	2	2	1	4	14 28.0%	36 72.0%	50 7.0%
more than 5 hours	-	1	3	-	2	1	-	1	-	-	5 62.5%	3 37.5%	8 1.1%
TIME ACTIVITY DATA													
Ways to school													
walking	1	1	10	5	10	5	4	7	-	2	25 5.7%	20 4.5%	45 6.3%
motor vehicle	19	42	41	6	10	109	49	89	28	49	147 33.3%	295 66.7%	442 61.5%
car	8	15	4	84	82	11	2	4	-	2	96 21.7%	116 26.2%	212 29.5%
mass transportation	1	1	2	4	4	7	1	-	-	-	8 1.8%	12 2.7%	20 2.8%
Schooling (hours)	4	4	4	4	4	4	4	4	4	4	16.7%	16.7%	
Home-school transit (hours)	<1	<1	<1	<1-1.5	<1-1.5	<1-1.5	<1	<1	<1-1.5	<1-1.5	<4.2-6.3%	<4.2-6.3%	70% at home, 16% in classrooms, 4% in commuting, 2.7% in outdoor.
At home-living room (hours)	1-6	2-7	1-5	2-8	2-5.5	2-7	1-6	2-8	1-6	2-7	4.2-25.0%	8.3-33.3%	
outside home (hours)	<1-3	<1-2	1-2.5	<1-2	<1-3	<1-2	<1-3	1-2	1-3	<1-2	<4.2-12.5%	<4.2-8.3%	
At home-sleeping (hours)	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	25.0-37.5%	25.0-37.5%	
HEALTH STATUS													
Weight (kg) (average)	51.3	45.2	46.9	44.0	49.3	46.0	40.1	41.0	49.7	39.5	47.4	43.1	45.3
Height (cm) (average)	158.5	156.2	154.8	154.3	158.2	156.1	144.1	153.7	154.4	142.3	154.0	152.5	153.3
BMI for children (average)	20.4	18.5	19.6	18.5	19.7	18.9	19.3	17.3	20.9	19.5	20.0	18.5	
Respiratory problem													
no	20	48	13	68	87	117	49	77	21	20	190 38.9%	330 67.5%	520 72.3%
common cold	3	3	5	11	14	4	3	8	3	2	23 45.1%	28 54.9%	51 7.1%
cough	1	-	1	5	1	2	1	1	-	5	4 23.5%	13 76.5%	17 2.4%
cough and cold	1	6	2	4	3	3	3	5	1	-	10 35.7%	18 64.3%	28 3.9%
breathless	4	2	3	8	1	6	-	9	3	3	11 28.2%	28 71.8%	39 5.4%
COVID-19 Symptoms													
no	20	47	54	29	86	114	53	87	24	44	237 42.5%	321 57.5%	558 77.6%
ever	9	12	3	6	20	18	3	13	4	9	39 73.6%	58 109.4%	97 13.5%

Table S4. Time activity and microenvironments of schoolchildren participants during personal exposure sampling.

School	Student	at home (hours)				Total	transit (hours)		Total	School environments		Total	Others		Total
		Living room	Kitchen/dinner room	Bedroom	outside home		for schooling	for others		classroom	outside classroom		indoor	outdoor	
U1	1	2	1.75	1.25	1	6	0.5	0	0.5	3	1.5	4.5	0	0	0
	2	1.75	4	0.75	0	6.5	0.5	0	0.5	2.25	2.75	5	0	0	0
	3	2.5	1.75	1	1.25	6.5	0.5	0	0.5	2.75	1.75	4.5	0	0	0
	4	2.25	2.25	2	0	6.5	0.5	0.5	1	1.75	2.25	4	0	0	0
	5	2.25	0.5	2.75	2	7.5	0.75	0	0.75	2	1.75	3.75	0	0	0
U2	6	3.25	1.5	1.25	0.5	6.5	1	0	1	2.5	2	4.5	0	0	0
	7	1	2	1.25	0	4.25	0.5	0	0.5	3	0	3	0	3	3
	8	0.5	3	1.5	1	6	0.25	0	0.25	5	0.5	5.5	0	0	0
	9	0.75	3	3.25	0	7	0.5	0	0.5	2.75	0.75	3.5	0	0	0
	10	0.75	4.5	1	0.25	6.5	0.25	0.25	0.5	4	0.25	4.25	0	0	0
	11	1.5	2.5	2	0	6	0.5	0	0.5	2.75	1.25	4	0	0	0
	12	2	2	2	0	6	0.25	0	0.25	1.25	1.75	3	1	0	1
	13	1	3	2	0	6	0.25	0	0.25	2.25	0.75	3	1	0	1
U3	14	1.75	1.25	2	1	6	0.5	0.5	1	2	3	5	0	0	0
	15	0.25	4	1	0	5.25	0.25	0	0.25	3	0.5	3.5	0	1	1
	16	4.75	0.25	0	0	5	0.5	0	0.5	2.75	0.25	3	0	2	2
	17	2.75	1.25	2.5	0	6.5	0.25	0.5	0.75	1.75	1.75	3.5	0	0	0
	18	1.25	2.5	2.25	1	7	0.25	0.75	1	4	0	4	0	0	0
	19	1.5	0.5	3	0	5	0.25	0.25	0.5	3	0	3	2	0	2
SU1	20	0.75	1.5	2.5	1.25	6	0.5	0.5	1	3.25	0.75	4	0	0	0
	21	5	0	1	0	6	0.5	0	0.5	3.5	0	3.5	1	0	1
	22	2.25	2.5	2	0	6.75	0.5	0	0.5	4.25	0.5	4.75	0	0	0
	23	1.5	0.75	3	0.75	6	0.5	0.5	0.5	3.25	0.75	4	0	0	0
	24	1.75	1.75	3	0	6.5	0.25	0.25	0.5	2.25	2.75	5	0	0	0
	25	2.25	3	1.25	0	6.5	1	0	1	2.75	2	4.75	0	0	0
	26	3.5	0.5	2.5	0	6.25	0.5	0	0.5	3.75	0.25	4	0	0	0
	27	1.25	0.75	3.75	0.25	6	0.75	0	0.75	4.75	0.25	5	0	0	0

Continued...

School	Student	at home (hours)				Total	transit (hours)		Total			Total	Others		Total
		Living room	Kitchen/dinner room	Bedroom	Others (home)		for schooling	for others		classroom	outside classroom		indoor	Outdoor	
SU2	28	2.5	1.75	1.25	1.25	6.75	0.5	0	0.5	3	1.75	4.75	0	0	0
	29	1.75	1.25	1.25	2.25	6.5	0.25	0.25	0.5	3.75	0.25	4	0	1	1
	30	1.5	3	1.5	1	7	0.25	0.5	0.75	2.5	1.75	4.25	0	3.75	0
	31	2.25	0.75	2	2.25	7.25	0.75	0	0.75	4	0.5	4.5	0	0	0
	32	1	0.5	3.5	1	6	0.25	0.25	0.5	4	0.25	4.25	1.25	0	0
	33	0	1.75	3.75	1.5	7	0.25	0	0.25	4	0.75	4.75	0	0	0
	34	2	2	0.75	0.5	5.25	0.25	0	0.25	3.5	0	3.5	0	0	1