

Supplementary Material

Table S1. List of AQS monitors included for nearest monitor selection. Monitors were required to have collected data during the entire study period.

Monitor ID
060370002
060371103
060372005
060658001
170310022
170310052
170312001
170313301
170314201
245100007
271230868
340030003
340310005
360050080
360050110
370670022

Table S2. Number of participants monitored and number with nonmissing and valid components for one or more 2-week rounds of air monitoring.

	W-S	NY	Baltimore	St. Paul	Chicago	LA	Total
Monitored Once	1	1	2	0	0	0	4
Monitored Twice	12	20	12	13	13	16	86
All components valid for one round	5	5	3	5	3	8	29
All components valid for two rounds	5	3	10	7	4	2	31
N, All components at least one round	10	8	13	12	7	10	60

Table S3. Summary statistics of total PM_{2.5} and sulfur measurements (n=91 total 2-week rounds, including 31 participants with 2 rounds (62 rounds) and 29 participants with 1 round of sampling). All values are in µg/m³.

	Mean	SD	Min	25 th	Median	75 th	Max
Outdoor PM_{2.5}	13.8	5.6	5.8	10.1	12.9	16.9	43.9
Indoor PM_{2.5}	9.8	5.0	0.9	5.8	8.6	12.8	27.6
Personal PM_{2.5}	11.8	6.1	0.1	7.8	10.9	14.1	34.0
Outdoor Sulfur	1.3	0.7	0.2	0.8	1.1	1.7	3.5
Indoor Sulfur	0.7	0.5	0.0	0.4	0.6	0.9	2.0
Personal Sulfur	0.7	0.4	0.1	0.4	0.6	0.9	2.0

Table S4. Summary statistics of metrics for exposure to ambient-origin PM_{2.5} (n=91 total 2-week rounds, including 31 participants with 2 rounds (62 rounds) and 29 participants with 1 round of sampling). All values are in µg/m³.

	Mean	SD	Min	25 th	Median	75 th	Max
1. PM_{2.5}-pers(m)	7.6	3.7	2.1	4.8	6.7	9.1	21.6
2. PM_{2.5}-out(m)	13.8	5.6	5.8	10.1	12.9	16.9	43.9
3. PM_{2.5}-out(p)	13.0	4.6	5.9	9.3	12.3	15.8	33.9
4. PM_{2.5}-out(nm)	13.4	5.1	4.9	10.1	12.8	15.9	37.2
5. PM_{2.5}-in(m)	7.9	5.5	0.0	4.8	6.6	9.0	42.2
6. PM_{2.5}-in(p)	7.6	4.0	3.1	5.1	6.3	8.1	26.8
7. PM_{2.5}-pers(m-alt)	8.5	5.4	1.2	5.2	7.4	9.5	42.3
8. PM_{2.5}-pers(p)	8.0	4.0	3.7	5.5	6.9	8.8	27.7

Table S5. Summary statistics of metrics for exposure to ambient-origin PM_{2.5} for 31 participants with 2 2-week rounds of sampling. The value among averaged repeat measurements is shown in parentheses. All values are in µg/m³.

	Mean	SD	Min	25 th	Median	75 th	Max
1. PM_{2.5}-pers(m)	7.2 (7.2)	3.1 (2.7)	2.6 (3.4)	4.7 (5.5)	6.8 (6.5)	8.9 (8.1)	17.7 (14.0)
2. PM_{2.5}-out(m)	13.4 (13.4)	4.4 (3.0)	7.5 (8.5)	10.2 (11.1)	12.6 (13.8)	15.1 (15.2)	29.2 (21.5)
3. PM_{2.5}-out(p)	13.5 (13.5)	5.0 (3.8)	6.8 (7.9)	10.4 (11.4)	13.0 (13.2)	15.9 (14.7)	37.2 (26.0)
4. PM_{2.5}-out(nm)	12.9 (12.9)	4.4 (3.3)	7.5 (8.3)	9.8 (10.9)	12.5 (13.0)	14.8 (14.3)	33.9 (24.6)
5. PM_{2.5}-in(m)	7.4 (7.4)	4.0 (3.3)	0.9 (3.3)	4.6 (4.8)	6.8 (6.7)	8.9 (8.6)	24.4 (18.2)
6. PM_{2.5}-in(p)	7.4 (7.4)	4.0 (3.4)	3.1 (3.5)	5.1 (5.7)	6.3 (6.4)	7.9 (7.7)	26.8 (20.1)
7. PM_{2.5}-pers(m-alt)	8.0 (8.0)	3.9 (3.2)	2.9 (3.7)	5.2 (5.7)	7.3 (7.3)	9.4 (8.7)	25.3 (18.8)
8. PM_{2.5}-pers(p)	7.8 (7.8)	4.0 (3.4)	3.7 (3.9)	5.6 (6.2)	6.6 (6.7)	8.2 (8.2)	27.7 (20.6)

Table S6. Root Mean Squared Error between metrics for exposure to ambient-origin PM_{2.5} among all measurements (n=91 total 2-week rounds, including 31 participants with 2 rounds (62 rounds) and 29 participants with 1 round of sampling). Primary comparisons are shaded. All values are in $\mu\text{g}/\text{m}^3$.

	1. PM _{2.5} -pers(m)	2. PM _{2.5} -out(m)	3. PM _{2.5} -out(p)	4. PM _{2.5} -out(nm)	5. PM _{2.5} -in(m)	6. PM _{2.5} -in(p)	7. PM _{2.5} -pers(m-alt)	8. PM _{2.5} -pers(p)
	pers(m)	out(m)	out(p)	out(nm)	in(m)	in(p)	pers(m-alt)	pers(p)
1. PM _{2.5} -pers(m)	0.00	2.68	2.88	3.35	1.77	2.19	1.78	2.23
2. PM _{2.5} -out(m)	4.02	0.00	3.35	3.98	3.60	4.36	3.39	4.27
3. PM _{2.5} -out(p)	3.53	2.75	0.00	2.27	3.80	2.90	3.70	2.79
4. PM _{2.5} -out(nm)	4.60	3.64	2.54	0.00	4.61	3.96	4.53	3.86
5. PM _{2.5} -in(m)	2.59	3.52	4.54	4.92	0.00	3.53	0.55	3.53
6. PM _{2.5} -in(p)	2.37	3.15	2.56	3.13	2.61	0.00	2.58	0.38
7. PM _{2.5} -pers(m-alt)	2.58	3.27	4.36	4.77	0.54	3.44	0.00	3.42
8. PM _{2.5} -pers(p)	2.42	3.09	2.47	3.05	2.61	0.38	2.57	0.00

Table S7. Pearson correlations between metrics for exposure to ambient-origin PM_{2.5}. Correlations are those among 31 participants with 2 2-week rounds of sampling. The value among averaged repeat measurements is shown in parentheses. Primary comparisons are shaded.

	1. PM _{2.5} -pers(m)	2. PM _{2.5} -out(m)	3. PM _{2.5} -out(p)	4. PM _{2.5} -out(nm)	5. PM _{2.5} -in(m)	6. PM _{2.5} -in(p)	7. PM _{2.5} -pers(m-alt)
2. PM _{2.5} -out(m)	0.56 (0.51)						
3. PM _{2.5} -out(p)	0.67 (0.66)	0.86 (0.91)					
4. PM _{2.5} -out(nm)	0.48 (0.40)	0.77 (0.85)	0.85 (0.83)				
5. PM _{2.5} -in(m)	0.90 (0.92)	0.61 (0.57)	0.70 (0.70)	0.56 (0.52)			
6. PM _{2.5} -in(p)	0.79 (0.81)	0.56 (0.59)	0.77 (0.78)	0.65 (0.59)	0.87 (0.89)		
7. PM _{2.5} -pers(m-alt)	0.89 (0.92)	0.65 (0.59)	0.72 (0.72)	0.58 (0.55)	0.99 (0.99)	0.87 (0.89)	
8. PM _{2.5} -pers(p)	0.78 (0.80)	0.57 (0.59)	0.78 (0.78)	0.66 (0.60)	0.87 (0.88)	1.00 (1.00)	0.87 (0.89)

Table S8. Relative percent difference ($|X-Y|/\text{mean}(X,Y)$) between metrics for exposure to ambient-origin $\text{PM}_{2.5}$. Values given are those among 31 participants with 2 2-week rounds of sampling, with the averaged repeat measurements in parentheses. Primary comparisons are shaded.

	1. $\text{PM}_{2.5}$ - pers(m)	2. $\text{PM}_{2.5}$ - out(m)	3. $\text{PM}_{2.5}$ - out(p)	4. $\text{PM}_{2.5}$ - out(nm)	5. $\text{PM}_{2.5}$ - in(m)	6. $\text{PM}_{2.5}$ - in(p)	7. $\text{PM}_{2.5}$ - pers(m-alt)
2. $\text{PM}_{2.5}$ -out(m)	62% (62%)						
3. $\text{PM}_{2.5}$ -out(p)	59% (59%)	12% (8%)					
4. $\text{PM}_{2.5}$ -out(nm)	63% (63%)	16% (12%)	14% (11%)				
5. $\text{PM}_{2.5}$ -in(m)	15% (11%)	62% (61%)	58% (57%)	62% (61%)			
6. $\text{PM}_{2.5}$ -in(p)	23% (19%)	62% (62%)	58% (58%)	63% (63%)	24% (18%)		
7. $\text{PM}_{2.5}$ -pers(m-alt)	14% (13%)	54% (53%)	50% (49%)	54% (54%)	10% (9%)	23% (19%)	
8. $\text{PM}_{2.5}$ -pers(p)	23% (19%)	57% (57%)	53% (52%)	58% (58%)	24% (19%)	6% (6%)	21% (17%)

Table S9. RMSE between metrics for exposure to ambient-origin $\text{PM}_{2.5}$. The main values given are those among 31 participants with 2 2-week rounds of sampling. The value among averaged repeat measurements is shown in parentheses. All units are $\mu\text{g}/\text{m}^3$. Primary comparisons are shaded.

	1. $\text{PM}_{2.5}$ - pers(m)	2. $\text{PM}_{2.5}$ - out(m)	3. $\text{PM}_{2.5}$ - out(p)	4. $\text{PM}_{2.5}$ - out(nm)	5. $\text{PM}_{2.5}$ - in(m)	6. $\text{PM}_{2.5}$ - in(p)	7. $\text{PM}_{2.5}$ - pers(m-alt)	8. $\text{PM}_{2.5}$ - pers(p)
1. $\text{PM}_{2.5}$ -pers(m)	0.00 (0.00)	2.56 (2.30)	2.29 (2.01)	2.72 (2.46)	1.33 (1.02)	1.90 (1.57)	1.39 (1.07)	1.93 (1.60)
2. $\text{PM}_{2.5}$ -out(m)	3.62 (2.57)	0.00 (0.00)	2.22 (1.27)	2.82 (1.59)	3.46 (2.47)	3.62 (2.43)	3.33 (2.43)	3.59 (2.43)
3. $\text{PM}_{2.5}$ -out(p)	3.24 (2.43)	2.21 (1.38)	0.00 (0.00)	2.27 (1.83)	3.14 (2.30)	2.78 (2.04)	3.04 (2.26)	2.72 (2.02)
4. $\text{PM}_{2.5}$ -out(nm)	4.40 (3.42)	3.22 (1.98)	2.60 (2.11)	0.00 (0.00)	4.16 (3.19)	3.81 (3.01)	4.07 (3.11)	3.75 (2.98)
5. $\text{PM}_{2.5}$ -in(m)	1.69 (1.25)	3.10 (2.68)	2.83 (2.31)	3.27 (2.78)	0.00 (0.00)	1.91 (1.47)	0.48 (0.35)	1.95 (1.52)
6. $\text{PM}_{2.5}$ -in(p)	2.43 (1.97)	3.26 (2.72)	2.52 (2.11)	3.01 (2.71)	1.92 (1.52)	0.00 (0.00)	1.93 (1.52)	0.31 (0.27)
7. $\text{PM}_{2.5}$ -pers(m-alt)	1.75 (1.27)	2.95 (2.57)	2.70 (2.20)	3.16 (2.64)	0.48 (0.34)	1.89 (1.43)	0.00 (0.00)	1.90 (1.46)
8. $\text{PM}_{2.5}$ -pers(p)	2.48 (1.99)	3.26 (2.71)	2.47 (2.08)	2.98 (2.67)	1.97 (1.56)	0.31 (0.27)	1.95 (1.54)	0.00 (0.00)

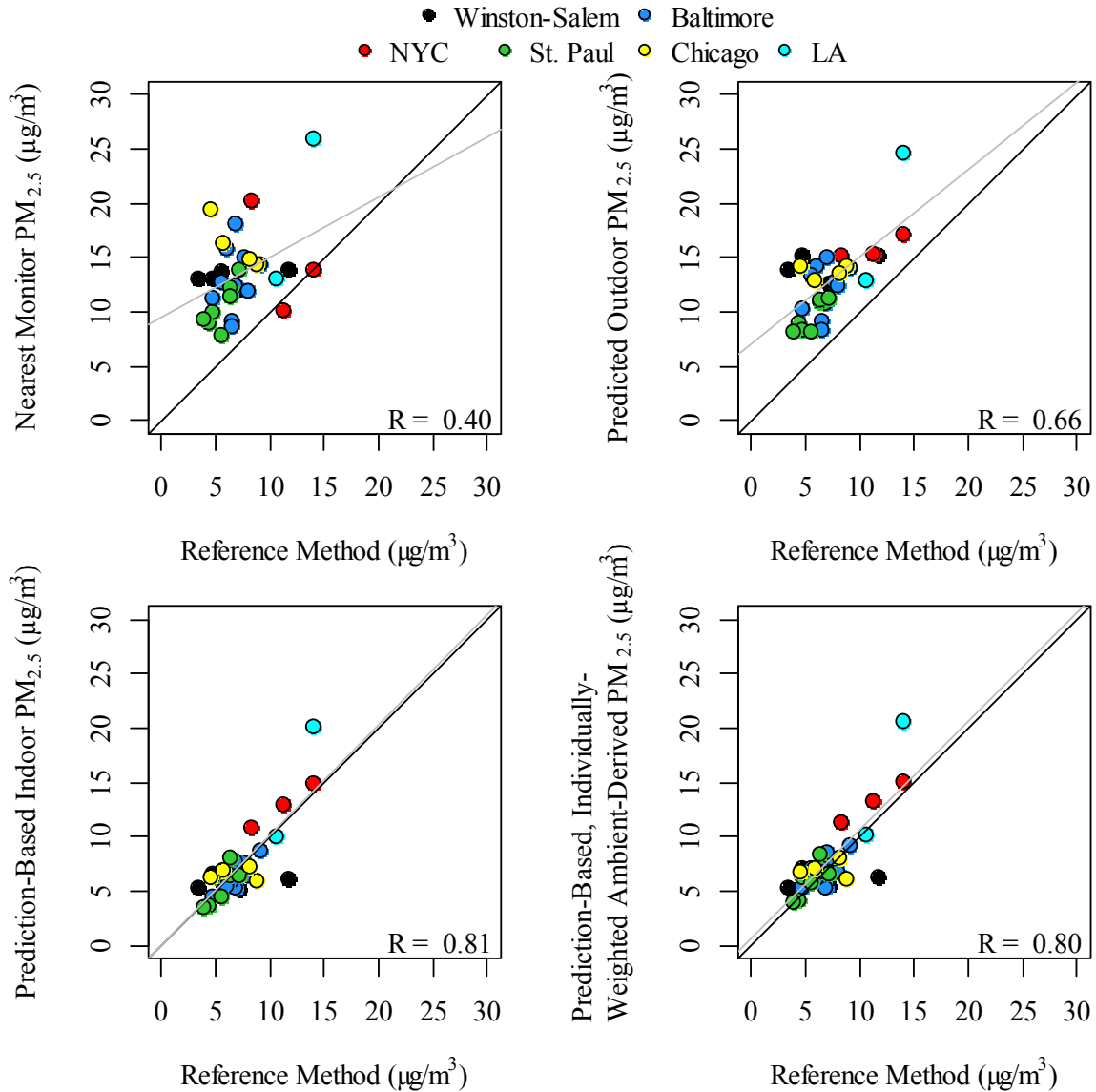


Figure S1. Comparison between reference method ($(\text{Sulfur}_{2.5\text{-pers}} / \text{Sulfur}_{2.5\text{-out}}) * \text{PM}_{2.5\text{-out(m)}}$) and four metrics for exposure to ambient-origin PM_{2.5}: 1) Average concentration at nearest regulatory monitor, 2) outdoor ($\text{PM}_{2.5\text{-out(p)}}$), 3) indoor ($\text{PM}_{2.5\text{-in(p)}}$), and 4) individually-weighted, ambient derived ($\text{PM}_{2.5\text{-out(p)}} * t_{\text{out-MAQ}} + F_{\text{inf(p)}} * \text{PM}_{2.5\text{-out(p)}} * (1 - t_{\text{out-MAQ}})$) for 31 individuals averaged over 2 2-week rounds of sampling. All metrics are ambient origin PM_{2.5}, not total PM_{2.5}. Predicted outdoor PM_{2.5} is expected to be higher than personal exposure due to the attenuation by infiltration and time spent indoors. The 1-1 line (black) and best fit line (gray) are shown for reference.

Table S10. Pearson correlation between reference exposure metric and other metrics for exposure to ambient-origin PM_{2.5} using all valid 2-week observations.

	N	R
1. PM _{2.5} -pers(m)	--	1.00
2. PM _{2.5} -out(m)	105	0.68
3. PM _{2.5} -out(p)	105	0.60
4. PM _{2.5} -out(nm)	105	0.42
5. PM _{2.5} -in(m)	94	0.87
6. PM _{2.5} -in(p)	105	0.79
7. PM _{2.5} -pers(m-alt)	91	0.88
8. PM _{2.5} -pers(p)	105	0.78

Table S11. Summary statistics for all metrics for exposure to ambient-origin PM_{2.5}, among all valid 2-week samples. All values are in µg/m³.

	N	Mean	SD	Min	25th	Median	75th	Max
1. PM _{2.5} -pers(m)	105	7.6	3.9	1.4	4.8	6.7	9.0	23.1
2. PM _{2.5} -out(m)	142	14.0	5.9	0.6	10.3	13.0	17.0	43.9
3. PM _{2.5} -out(p)	162	13.5	4.9	4.9	10.2	13.0	16.1	37.2
4. PM _{2.5} -out(nm)	160	13.6	4.8	5.3	10.3	12.9	16.3	34.0
5. PM _{2.5} -in(m)	142	8.5	5.8	0.0	4.9	7.0	10.7	42.2
6. PM _{2.5} -in(p)	160	8.6	4.4	1.7	5.8	7.5	10.1	28.9
7. PM _{2.5} -pers(m-alt)	114	9.2	5.7	1.2	5.8	7.8	10.9	42.3
8. PM _{2.5} -pers(p)	160	8.2	4.4	1.7	5.3	7.2	9.8	28.7

Table S12. Comparison between infiltration model developed using full data and estimation of the same model excluding the personal monitoring homes.

Cold Season Model			
Variable	Full Data	Excludes Personal Monitoring Homes	Difference
Intercept	0.52254	0.52020	< 1%
Temperature	0.01124	0.01081	4%
Forced Air Heat	-0.11699	-0.10679	9%
July Window > Half of Days	0.08385	0.09455	12%
Double Pane Windows	-0.05155	-0.06382	21%
January Window > Half of Days	0.05255	0.05926	12%
Warm Season Model (> 18 deg C)			
Intercept	0.72427	0.71831	< 1%
Very Warm (> 25 deg C)	0.00851	0.01091	25%
Central Air July > Half	-0.21515	-0.21949	2%
Central Air July * Very Warm	-0.16320	-0.16204	< 1%
July Window > Half of Days	0.14807	0.15962	8%
Central July Few	-0.09653	-0.11896	21%

Figure S2. Comparison between F_{inf} calculated by each method for personal monitoring homes. $R^2 = 0.997$. Maximum difference is 0.026.

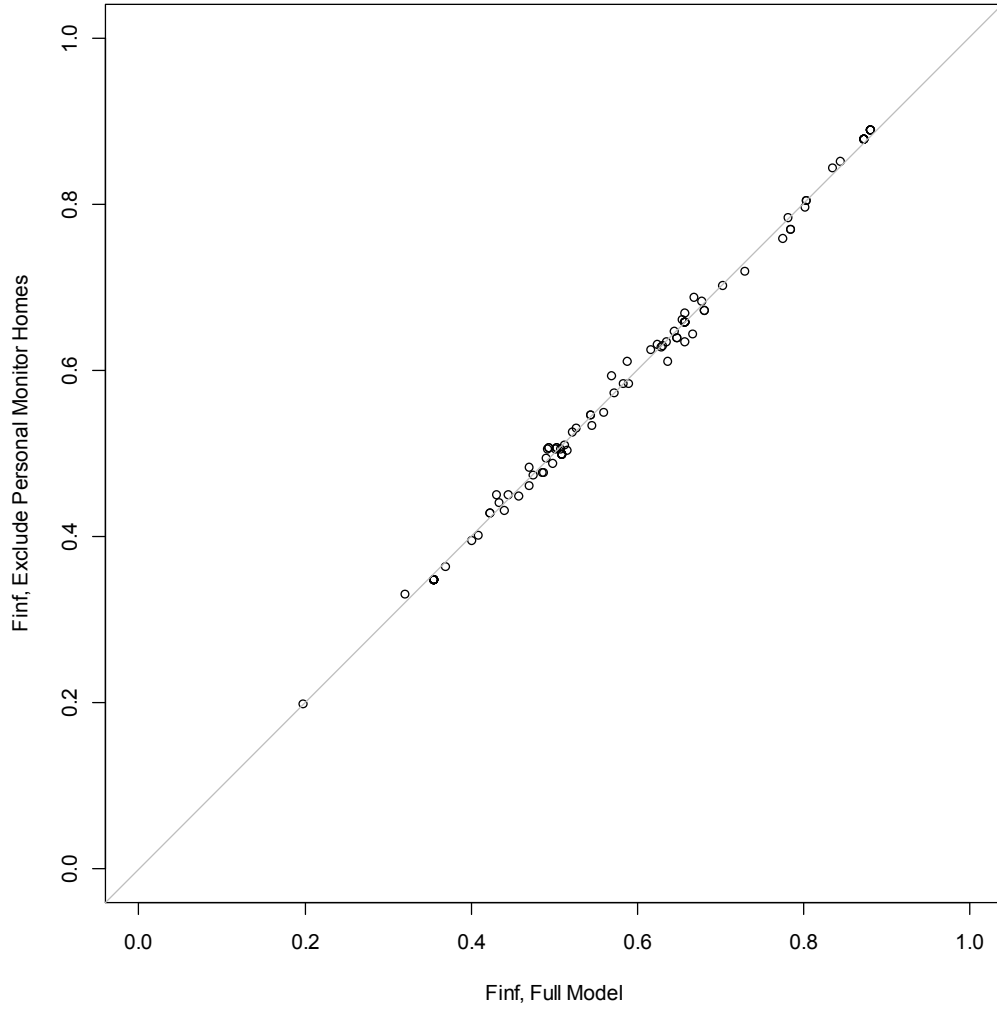


Table S13. Explanatory value of demographic characteristics on the comparison between reference personal exposure metric and predicted personal exposure. Values are p-values from likelihood ratio tests comparing models with and without additional demographic variables. Linear mixed models were used to account for correlation within participants. Each demographic characteristic was evaluated separately with and without site adjustment.

	No site adjustment	With site adjustment
Age (linear in years)	0.16	0.41
Sex (Binary: Male or Female)	0.77	0.61
Race/Ethnicity (Categories: white, Chinese, Black, Hispanic)	0.71	0.69
Building Type (Categories: Single Family, Rowhouse, Apt/Condo \geq 6 stories, Apt/Condo $<$ 6 stories, Du/Triplex)	0.94	0.99
City (Categories: clinic center)	0.56	N/A
Season (Categories: cold, warm, very warm)	0.13	0.18
Month of Sample (Categories: each calendar month)	0.15	0.20
Time in Transit (linear in percent)	0.74	0.82