

Supplementary Materials: Association between Long-term Exposure to PM_{2.5} and Lung Imaging Phenotype in CODA Cohort

Youlim Kim^{1,2}, So Hyeon Bak³, Sung Ok Kwon⁴, Ho Kim⁵, Woo Jin Kim⁶, Chang Youl Lee and MD^{1,2}

Table S1. Image measurements & PM_{2.5} concentration (per 5 ug/m³ increase) by smoking status.

Total (N=400)	EI _r [*]		Mean wall area (%)	
	β (95% CI)	p value	β (95% CI)	p value
Never smoker (N=136)				
1-year ⁺ , 1km	-0.156(-0.787, 0.475)	0.626	1.996(-3.175, 7.168)	0.445
1-year ⁺ , 3km	-0.067(-0.880, 0.746)	0.871	6.261(-0.291, 12.812)	0.061
1-year ⁺ , 5km	-0.166(-0.766, 0.433)	0.583	4.884(0.060, 9.708)	0.047
3-year ⁺⁺ , 1km	-0.335(-0.935, 0.265)	0.271	1.070(-3.814, 5.954)	0.665
3-year ⁺⁺ , 3km	-0.362(-1.125, 0.400)	0.348	4.285(-1.852, 10.422)	0.169
3-year ⁺⁺ , 5km	-0.375(-0.936, 0.186)	0.187	3.351(-1.180, 7.882)	0.145
5-year [#] , 1km	-0.338(-0.915, 0.239)	0.247	0.025(-4.654, 4.705)	0.992
5-year [#] , 3km	-0.368(-1.095, 0.359)	0.317	2.241(-3.629, 8.110)	0.450
5-year [#] , 5km	-0.352(-0.882, 0.178)	0.190	2.073(-2.217, 6.363)	0.340
Ex-smoker (N=174)				
1-year ⁺ , 1km	0.087(-0.125, 0.299)	0.419	-0.354(-3.019, 2.311)	0.793
1-year ⁺ , 3km	0.107(-0.142, 0.356)	0.399	-0.361(-3.494, 2.773)	0.820
1-year ⁺ , 5km	0.051(-0.211, 0.314)	0.699	-1.682(-4.964, 1.600)	0.313
3-year ⁺⁺ , 1km	0.052(-0.146, 0.249)	0.606	-1.256(-3.749, 1.237)	0.321
3-year ⁺⁺ , 3km	0.064(-0.166, 0.293)	0.585	-1.273(-4.173, 1.628)	0.387
3-year ⁺⁺ , 5km	0.014(-0.226, 0.254)	0.911	-2.493(-5.507, 0.522)	0.104
5-year [#] , 1km	0.053(-0.127, 0.233)	0.563	-1.083(-3.373, 1.207)	0.352
5-year [#] , 3km	0.061(-0.147, 0.269)	0.563	-1.115(-3.765, 1.534)	0.407
5-year [#] , 5km	0.018(-0.198, 0.234)	0.869	-2.069(-4.795, 0.656)	0.136
Current smoker (N=90)				
1-year ⁺ , 1km	0.029(-0.435, 0.493)	0.901	-1.699(-6.729, 3.331)	0.503
1-year ⁺ , 3km	0.050(-0.630, 0.730)	0.884	-3.854(-11.200, 3.492)	0.299
1-year ⁺ , 5km	-0.236(-0.752, 0.281)	0.366	-0.713(-6.358, 4.931)	0.802
3-year ⁺⁺ , 1km	0.064(-0.353, 0.481)	0.760	-2.670(-7.257, 1.917)	0.250
3-year ⁺⁺ , 3km	0.100(-0.510, 0.710)	0.745	-5.013(-11.678, 1.653)	0.138
3-year ⁺⁺ , 5km	-0.138(-0.584, 0.307)	0.537	-2.168(-7.089, 2.753)	0.383
5-year [#] , 1km	0.051(-0.318, 0.420)	0.784	-2.328(-6.433, 1.777)	0.262
5-year [#] , 3km	0.078(-0.438, 0.594)	0.765	-4.083(-9.802, 1.637)	0.159
5-year [#] , 5km	-0.109(-0.495, 0.277)	0.575	-1.914(-6.233, 2.405)	0.380

NOTE. PM, particulate matter; CI, confidence interval

^{*} EI_r is the log transformation of the emphysema index.

⁺1-year: annual average PM_{2.5} concentrations for the previous one year at the time of enrollment from the baseline examination.

⁺⁺3-year: annual average PM_{2.5} concentrations for the previous three year at the time of enrollment from the baseline examination.

[#]5-year: annual average PM_{2.5} concentrations for the previous five year at the time of enrollment from the baseline examination.

Adjusted for age, gender, education, height, weight, smoking, pack-years, medication use, asthma history, and annual average PM_{2.5} concentration for survey year.

Table S2. Image measurements & PM_{2.5} concentration (per 5 ug/m³ increase) by overweight/obese.

Total (N=400)	EI _r [*]		Mean wall area (%)	
	β (95% CI)	p value	β (95% CI)	p value
BMI<23 (N=184)				
1-year ⁺ , 1km	0.145(-0.113, 0.403)	0.268	-1.618(-4.340, 1.104)	0.242
1-year ⁺ , 3km	0.009(-0.344, 0.362)	0.960	-0.226(-3.955, 3.503)	0.905
1-year ⁺ , 5km	-0.093(-0.405, 0.218)	0.555	-0.713(-4.001, 2.576)	0.669
3-year ⁺⁺ , 1km	0.075(-0.170, 0.319)	0.547	-2.707(-5.331, -0.084)	0.043
3-year ⁺⁺ , 3km	-0.034(-0.371, 0.302)	0.842	-1.953(-5.600, 1.694)	0.292
3-year ⁺⁺ , 5km	-0.140(-0.428, 0.148)	0.338	-2.375(-5.489, 0.738)	0.134
5-year [#] , 1km	0.071(-0.153, 0.296)	0.532	-2.728(-5.131, -0.325)	0.026
5-year [#] , 3km	-0.019(-0.326, 0.288)	0.904	-2.603(-5.910, 0.704)	0.122
5-year [#] , 5km	-0.109(-0.370, 0.152)	0.413	-2.699(-5.507, 0.110)	0.060
23≤BMI<25 (N=92)				
1-year ⁺ , 1km	0.177(-0.353, 0.707)	0.508	2.690(-2.855, 8.235)	0.336
1-year ⁺ , 3km	0.364(-0.190, 0.918)	0.194	3.262(-2.573, 9.097)	0.269
1-year ⁺ , 5km	0.280(-0.238, 0.797)	0.284	3.665(-1.744, 9.074)	0.181
3-year ⁺⁺ , 1km	0.102(-0.378, 0.581)	0.674	1.549(-3.410, 6.508)	0.535
3-year ⁺⁺ , 3km	0.229(-0.273, 0.730)	0.366	1.984(-3.219, 7.187)	0.449
3-year ⁺⁺ , 5km	0.169(-0.303, 0.641)	0.478	2.653(-2.218, 7.523)	0.281
5-year [#] , 1km	0.053(-0.387, 0.493)	0.812	1.565(-3.026, 6.155)	0.499
5-year [#] , 3km	0.154(-0.308, 0.615)	0.508	1.958(-2.861, 6.777)	0.420
5-year [#] , 5km	0.108(-0.328, 0.544)	0.623	2.586(-1.936, 7.107)	0.258
25≤BMI (N=124)				
1-year ⁺ , 1km	-0.234(-0.672, 0.204)	0.291	1.172(-2.942, 5.287)	0.573
1-year ⁺ , 3km	-0.094(-0.632, 0.445)	0.731	-1.157(-6.192, 3.878)	0.649
1-year ⁺ , 5km	-0.228(-0.758, 0.301)	0.393	-0.246(-5.215, 4.723)	0.922
3-year ⁺⁺ , 1km	-0.260(-0.653, 0.133)	0.192	0.592(-3.149, 4.332)	0.754
3-year ⁺⁺ , 3km	-0.177(-0.655, 0.301)	0.464	-1.178(-5.690, 3.333)	0.605
3-year ⁺⁺ , 5km	-0.265(-0.727, 0.197)	0.257	-0.752(-5.138, 3.633)	0.734
5-year [#] , 1km	-0.202(-0.564, 0.160)	0.271	0.433(-3.018, 3.884)	0.803
5-year [#] , 3km	-0.111(-0.543, 0.321)	0.611	-1.019(-5.105, 3.067)	0.621
5-year [#] , 5km	-0.184(-0.597, 0.230)	0.380	-0.668(-4.594, 3.258)	0.736

NOTE. PM, particulate matter; CI, confidence interval; BMI, body mass index.

^{*} EI_r is the log transformation of the emphysema index.

⁺1-year: annual average PM_{2.5} concentrations for the previous one year at the time of enrollment from the baseline examination.

⁺⁺3-year: annual average PM_{2.5} concentrations for the previous three year at the time of enrollment from the baseline examination.

[#]5-year: annual average PM_{2.5} concentrations for the previous five year at the time of enrollment from the baseline examination.

Adjusted for age, gender, education, height, weight, smoking, pack-years, medication use, asthma history, and annual average PM_{2.5} concentration for survey year.

Table S3. Image measurements & PM_{2.5} concentration (per 5 ug/m³ increase) by CCI (≥1).

	Emphysema index			<i>p</i> value
	β	95% CI		
		Lower	Upper	
1-year ⁺				
1km	1.508	-3.068	6.085	0.516
3km	3.162	-2.527	8.850	0.274
5km	-1.276	-6.175	3.623	0.607
3-year ⁺⁺				
1km	0.928	-3.222	5.078	0.659
3km	2.098	-3.032	7.229	0.420
5km	-1.423	-5.785	2.940	0.520
5-year [#]				
1km	0.793	-3.016	4.603	0.681
3km	1.720	-2.953	6.394	0.468
5km	-1.248	-5.216	2.721	0.535

NOTE. PM, particulate matter; CCI, charlson comorbidity index; CI, confidence interval

⁺1-year: annual average PM_{2.5} concentrations for the previous one year at the time of enrollment from the baseline examination.

⁺⁺3-year: annual average PM_{2.5} concentrations for the previous three year at the time of enrollment from the baseline examination.

[#]5-year: annual average PM_{2.5} concentrations for the previous five year at the time of enrollment from the baseline examination.

Table S4. Association between lung imaging and personal factors.

Total (N=400)	Emphysema index		Mean wall area (%)	
	β (95% CI)	<i>p</i> value	β (95% CI)	<i>p</i> value
Cities				
Gangneung	Ref.		Ref.	
Donghae	0.28(-2.60, 3.17)	0.848	1.74(-0.72, 4.20)	0.164
Samcheok	-0.41(-2.31, 1.50)	0.675	0.36(-1.27, 1.98)	0.666
Yeongwol	1.18(-0.80, 3.16)	0.243	2.82(1.13, 4.51)	0.001
Danyang	1.32(-1.50, 4.14)	0.357	1.51(-0.89, 3.92)	0.216
Jecheon	1.86(-0.26, 3.98)	0.085	2.90(1.09, 4.70)	0.002
Age				
44-59 year	Ref.		Ref.	
60-69 year	-1.59(-4.20, 1.02)	0.231	-1.40(-3.66, 0.86)	0.224
70-79 year	-0.93(-3.44, 1.59)	0.470	-0.68(-2.86, 1.51)	0.543
80-96 year	-0.66(-3.72, 2.41)	0.675	-1.32(-3.98, 1.34)	0.328
Sex				
Male	Ref.		Ref.	
Female	-1.68(-4.48, 1.11)	0.237	-0.51(-2.94, 1.91)	0.677
Smoking status				
Never smoker	Ref.		Ref.	
Ex-smoker	3.50(1.33, 5.67)	0.002	-3.17(-5.06, -1.29)	0.001
Current smoker	0.83(-1.56, 3.21)	0.496	-2.74(-4.81, -0.67)	0.010

Note. CI, confidence interval

Table S5. Baseline characteristics of normal healthy volunteers.

Characteristics	Normal (N=132)	COPD (N=268)
Sex, male (%)	82(62.1)	219(81.7)
Age (years)	70.5±8.1	72.3±6.9
BMI (kg/m ²)		
< 23.0	51(38.7)	133(49.6)
23.0-24.9	32(24.2)	60(22.4)
≥ 25.0	49(37.1)	75(28.0)
Smoking status		
Never smoker	69(52.3)	67(25.0)
Ex-smoker	44(33.3)	130(48.5)
Current smoker	19(14.4)	71(26.5)
Smoking amount (pack-years)	12.6±18.9	21.3±25.6
Pulmonary Function Test, post bronchodilator response		
FVC, L	2.9±0.8	3.1±0.8
FVC, % predicted	95.9±19.2	97.7±18.9
FEV ₁ , L	2.2±0.6	1.8±0.6
FEV ₁ , % predicted	99.7±21.6	79.6±19.6
FEV ₁ /FVC	0.8±0.1	0.6±0.1

Note. Data are expressed as mean ± standard deviation or N (%), BMI, body mass index; FVC, forced vital capacity; FEV₁, forced expiratory volume in 1 second