

Supplemental Material

Association of Long-term PM_{2.5} Exposure with Traditional and Novel Lipid Measures Related to Cardiovascular Disease Risk

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Supplemental Table 1. CATHGEN participant characteristics by study inclusion status

Characteristic	Included (N=6,587)	Excluded (N=2,703)
Age at time of enrollment	60.8 ± 12.1	60.8 ± 12.1
Body mass index (kg/m ²)	30.1 ± 7.3	30.1 ± 6.9
Coronary Artery Disease		
Yes	2950 (50)	1255 (49)
No	2976 (50)	1230 (51)
Sex		
Male	3,991 (61)	1,814 (66)
Female	2,596 (39)	933 (34)
Race		
Non-Hispanic white	4,853 (74)	2,128 (77)
African American	1,340 (20)	438 (16)
Other	394 (6)	181 (7)
History of smoking		
Yes	3,152 (48)	1,287 (47)
No	3,435 (52)	1,460 (53)
History of diabetes		
Yes	1,886 (29)	754 (28)
No	4,701 (71)	1949 (72)

Supplemental Table 2. Mean LDL levels by participant characteristics

	Total LDL-P (Mean ± SD)	Small LDL-P (Mean ± SD)	NMR LDL-C (Mean ± SD)
CAD >23			
Yes	1462 ± 457	1194 ± 442	98 ± 33
No	1460 ± 436	1135 ± 458*	99 ± 31
Age at time of enrollment			
<65	1494 ± 460	1191 ± 475	100 ± 32
≥65	1389 ± 414*	1104 ± 403*	94 ± 30*
Sex			
Male	1409 ± 437	1148 ± 440	94 ± 31
Female	1519 ± 450*	1171 ± 464*	104 ± 32*
Body mass index (kg/m²)			
<18.5 (Underweight)	1377 ± 409	1059 ± 392	94 ± 31
18.5-24.9 (Normal weight)	1410 ± 425	1060 ± 427	97 ± 31
25.0-29.9 (Overweight)	1431 ± 429	1137 ± 428	96 ± 31
≥30.0 (Obese)	1495 ± 466*	1224 ± 468*	100 ± 32*
Race			
Non-Hispanic white	1440 ± 431	1159 ± 441	96 ± 31
African American	1504 ± 500	1159 ± 490	103 ± 36
Other	1437 ± 404*	1127 ± 413	97 ± 29*
History of smoking			
Yes	1454 ± 435	1178 ± 444	97 ± 31
No	1451 ± 454	1138 ± 455*	98 ± 32
History of diabetes			
Yes	1433 ± 470	1187 ± 471	95 ± 33
No	1460 ± 435*	1145 ± 440*	99 ± 31*
Area level education			
Low	1476 ± 454	1186 ± 459	99 ± 32
High	1437 ± 439*	1137 ± 442*	97 ± 31*
Urban/rural status			
Urban	1431 ± 441	1123 ± 442	97 ± 32
Rural	1468 ± 448*	1181 ± 454*	99 ± 32*

Data are shown as mean ± SD. CAD, coronary artery disease; LDL, low-density lipoprotein; NMR, nuclear magnetic resonance.

* $p < 0.05$ using ANOVA

Supplemental Table 3. Pearson Correlations for the lipoprotein measures

	Total LDL-P and Sizes				Total HDL-P and Sizes				Total TRL-P and Sizes				NMR-derived Lipids				
	Total LDL-P	Large LDL-P	Medium LDL-P	Small LDL-P	Total HDL-P	Large HDL-P	Medium HDL-P	Small HDL-P	Total TRL-P	Large TRL-P	Medium TRL-P	Small TRL-P	LDL-C	HDL-C	Tot TG	Tot Chol	Apo B
Total LDL-P	1.00																
Large LDL-P	0.24	1.00															
Medium LDL-P	0.23	0.18	1.00														
Small LDL-P	0.80	-0.19	-0.30	1.00													
Total HDL-P	0.11	0.05	0.15	0.03	1.00												
Large HDL-P	-0.11	0.24	0.11	-0.25	0.26	1.00											
Medium HDL-P	0.09	0.29	0.13	-0.07	0.28	0.10	1.00										
Small HDL-P	0.09	-0.22	0.03	0.15	0.71	-0.14	-0.41	1.00									
Total TRL-P	0.38	-0.09	-0.03	0.43	0.17	-0.28	-0.07	0.30	1.00								
Large TRL-P	0.13	-0.20	-0.14	0.27	0.15	-0.19	-0.10	0.28	0.50	1.00							
Medium TRL-P	0.21	-0.21	-0.19	0.37	0.10	-0.28	-0.15	0.29	0.72	0.68	1.00						
Small TRL-P	0.21	0.08	0.09	0.14	0.10	-0.13	-0.06	0.18	0.62	0.03	0.29	1.00					
LDL-C	0.96	0.45	0.35	0.63	0.10	-0.04	0.18	-0.01	0.27	0.00	0.05	0.21	1.00				
HDL-C	0.01	0.26	0.17	-0.16	0.74	0.76	0.49	0.15	-0.11	-0.06	-0.16	-0.06	0.08	1.00			
Total TG	0.28	-0.18	-0.12	0.40	0.17	-0.24	-0.08	0.30	0.74	0.84	0.84	0.32	0.14	-0.08	1.00		
Total Chol	0.89	0.39	0.30	0.61	0.36	0.09	0.25	0.16	0.54	0.23	0.31	0.37	0.90	0.31	0.42	1.00	
ApoB	0.96	0.25	0.26	0.74	0.15	-0.16	0.08	0.15	0.60	0.23	0.36	0.41	0.92	0.00	0.44	0.94	1.00

ApoB, apolipoprotein B; Chol, cholesterol; HDL, high-density lipoprotein; LDL, low-density lipoprotein; NMR, nuclear magnetic resonance; TG, triglyceride; TRL-P, TG-rich Lipoprotein Particle.

Supplemental Table 4. Adjusted^a associations between 1- $\mu\text{g}/\text{m}^3$ increases in annual average $\text{PM}_{2.5}$ and lipoprotein measures

	Beta coefficients (95% CI) per 1- $\mu\text{g}/\text{m}^3$ increase	% Change from the mean outcome level (95% CI) per 1- $\mu\text{g}/\text{m}^3$ increase
LDL Particle (LDL-P) Concentrations (nmol/L)		
Total LDL-P	29.0 (20.0, 38.4)	2.00 (1.38, 2.64)
Large LDL-P	-1.10 (-4.41, 2.21)	-0.67 (-2.67, 1.34)
Medium LDL-P	4.16 (-0.27, 8.58)	3.15 (-0.20, 6.50)
Small LDL-P	26.0 (16.5, 35.4)	2.25 (1.43, 3.06)
HDL Particle (HDL-P) Concentrations ($\mu\text{mol}/\text{L}$)		
Total HDL-P	0.11 (0.03, 0.19)	0.60 (0.16, 1.03)
Large HDL -P	-0.01 (-0.03, 0.02)	-0.63 (-1.88, 1.25)
Medium HDL -P	0.12 (0.06, 0.17)	2.79 (1.40, 3.95)
Small HDL-P	-0.0002 (-0.08, 0.08)	-0.002 (-0.65, 0.65)
TG-rich Lipoprotein Particle (TRLP) Concentrations (nmol/L)		
Total TRL-P	3.96 (2.42, 5.50)	2.98 (1.82, 4.14)
Large TRL-P	0.11 (0.002, 0.21)	4.07 (0.07, 7.78)
Medium TRL-P	0.88 (0.45, 1.30)	4.54 (2.32, 6.70)
Small TRL-P	0.50 (-0.19, 1.20)	1.30 (-0.49, 3.11)
NMR-derived Lipid and Apolipoprotein Concentrations (mg/dL)		
LDL-C	1.66 (1.00, 2.32)	1.70 (1.02, 2.37)
HDL-C	0.27 (0.03, 0.50)	0.61 (0.07, 1.13)
Total triglycerides	3.49 (1.77, 5.21)	3.29 (1.67, 4.92)
Total cholesterol	2.69 (1.87, 3.51)	1.62 (1.13, 2.11)
ApoB	1.67 (1.15, 2.18)	2.06 (1.42, 2.69)

ApoB, apolipoprotein B; HDL, high-density lipoprotein; LDL, low-density lipoprotein; NMR, nuclear magnetic resonance; TG, triglyceride; TRL-P, TG-rich Lipoprotein Particle.

^aModels are adjusted for race, history of smoking, sex, age, area level education, urban/rural status, body mass index, and diabetes.