

465 **SUPPLEMENTARY MATERIAL:**466 **Supplementary Table 1:** Summary statistics of chemical components included in the analysis.

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Components	Mean (SD)
Bromine (ng/m ³)	2.63 (0.60)
Calcium (ng/m ³)	46.76 (21.22)
Copper (ng/m ³)	2.36 (1.77)
Elemental Carbon (µg/m ³)	0.50 (0.24)
Iron (ng/m ³)	60.55 (25.14)
Potassium (ng/m ³)	55.78 (11.08)
Nickel (ng/m ³)	0.89 (0.34)
Nitrate (µg/m ³)	0.48 (0.47)
Organic Carbon (µg/m ³)	1.09 (0.59)
Lead (ng/m ³)	1.64 (0.53)
Silicon (ng/m ³)	1.89 (0.82)
Sulfate (µg/m ³)	115.59 (48.86)
Vanadium (ng/m ³)	2.09 (0.75)
Zinc (ng/m ³)	0.58 (0.49)

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469 **Supplementary Table 2:** The associations between 10% increases in ZIP code characteristics
 470 and source categories. We fit generalized nonlinear models including each ZIP code
 471 characteristic separately to assess the independent associations with each source category. We
 472 adjusted for population density, RUCA, % population over 65, and % population female.
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Predictor	Source category	Estimate (95%CI)
% Below Poverty Line	PM _{2.5}	0.106 (0.086 ; 0.127)
	Soil and Crustal Dust	0.456 (0.428 ; 0.484)
	Heavy Fuel Oil and Industrial	0.313 (0.258 ; 0.369)
	Metal Processing Industry and Agricultural	0.197 (0.162 ; 0.233)
	Coal and Oil Combustion, and Biomass Burning	-0.171 (-0.189 ; -0.152)
	Motor Vehicle	0.787 (0.739 ; 0.835)
% No High School	PM _{2.5}	0.207 (0.186 ; 0.227)
	Soil and Crustal Dust	0.541 (0.513 ; 0.569)
	Heavy Fuel Oil and Industrial	0.251 (0.196 ; 0.307)
	Metal Processing Industry and Agricultural	0.219 (0.183 ; 0.255)
	Coal and Oil Combustion, and Biomass Burning	-0.049 (-0.068 ; -0.03)
	Motor Vehicle	0.6 (0.552 ; 0.649)
% Renters	PM _{2.5}	0.124 (0.113 ; 0.136)
	Soil and Crustal Dust	0.075 (0.059 ; 0.091)
	Heavy Fuel Oil and Industrial	0.547 (0.517 ; 0.578)
	Metal Processing Industry and Agricultural	0.23 (0.21 ; 0.25)
	Coal and Oil Combustion, and Biomass Burning	-0.203 (-0.213 ; -0.193)
	Motor Vehicle	0.712 (0.686 ; 0.738)
% Non-Hispanic Black	PM _{2.5}	0.079 (0.068 ; 0.091)
	Soil and Crustal Dust	-0.01 (-0.027 ; 0.006)
	Heavy Fuel Oil and Industrial	0.328 (0.296 ; 0.359)
	Metal Processing Industry and Agricultural	0.164 (0.144 ; 0.184)
	Coal and Oil Combustion, and Biomass Burning	-0.089 (-0.1 ; -0.078)
	Motor Vehicle	0.383 (0.356 ; 0.411)

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 475 **Supplementary Table 3:** The associations between ZIP code characteristics and source
 476 categories, stratified by US regions. We fit generalized nonlinear models including each ZIP
 477 code characteristic, separately, to assess the independent associations with each source category.
 478 Estimates are associated with a 10% change in the predictors. We adjusted for population
 479 density, RUCA, % population over 65, and % population female.
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Region	Predictor	Source category	Estimate (95%CI)
West	% Below Poverty Line	PM _{2.5}	0.509 (0.439 ; 0.579)
		Soil and Crustal Dust	0.64 (0.541 ; 0.739)
		Heavy Fuel Oil and Industrial	0.179 (0.033 ; 0.325)
		Metal Processing Industry and Agricultural	0.17 (0.081 ; 0.259)
		Coal and Oil Combustion, and Biomass Burning	-0.049 (-0.088 ; -0.01)
		Motor Vehicle	1.166 (1.017 ; 1.315)
	% No High School	PM _{2.5}	0.618 (0.561 ; 0.674)
		Soil and Crustal Dust	0.764 (0.683 ; 0.844)
		Heavy Fuel Oil and Industrial	-0.119 (-0.241 ; 0.002)
		Metal Processing Industry and Agricultural	0.456 (0.383 ; 0.529)
		Coal and Oil Combustion, and Biomass Burning	0.053 (0.021 ; 0.086)
		Motor Vehicle	1.076 (0.953 ; 1.199)
	% Renters	PM _{2.5}	0.328 (0.291 ; 0.365)

Region	Predictor	Source category	Estimate (95%CI)
		Soil and Crustal Dust	-0.069 (-0.123 ; -0.015)
		Heavy Fuel Oil and Industrial	0.695 (0.619 ; 0.771)
		Metal Processing Industry and Agricultural	0.184 (0.136 ; 0.231)
		Coal and Oil Combustion, and Biomass Burning	-0.121 (-0.142 ; -0.101)
		Motor Vehicle	0.875 (0.797 ; 0.953)
	% non-Hispanic Black	PM _{2.5}	0.507 (0.4 ; 0.614)
		Soil and Crustal Dust	0.177 (0.025 ; 0.329)
		Heavy Fuel Oil and Industrial	1.896 (1.682 ; 2.111)
		Metal Processing Industry and Agricultural	0.485 (0.351 ; 0.62)
		Coal and Oil Combustion, and Biomass Burning	-0.415 (-0.473 ; -0.356)
		Motor Vehicle	1.141 (0.912 ; 1.371)
South	% Below Poverty Line	PM _{2.5}	-0.013 (-0.036 ; 0.011)
		Soil and Crustal Dust	0.586 (0.541 ; 0.63)
		Heavy Fuel Oil and Industrial	0.227 (0.154 ; 0.3)
		Metal Processing Industry and Agricultural	-0.032 (-0.076 ; 0.012)
		Coal and Oil Combustion, and Biomass Burning	-0.172 (-0.202 ; -0.141)
		Motor Vehicle	0.744 (0.672 ; 0.817)
	% No High School	PM _{2.5}	-0.078 (-0.101 ; -0.054)
		Soil and Crustal Dust	0.617 (0.573 ; 0.661)
		Heavy Fuel Oil and Industrial	0.24 (0.167 ; 0.312)
		Metal Processing Industry and Agricultural	-0.126 (-0.169 ; -0.082)
		Coal and Oil Combustion, and Biomass Burning	-0.108 (-0.138 ; -0.078)
		Motor Vehicle	0.358 (0.285 ; 0.431)
	% Renters	PM _{2.5}	0.061 (0.047 ; 0.075)
		Soil and Crustal Dust	0.174 (0.147 ; 0.201)
		Heavy Fuel Oil and Industrial	0.229 (0.185 ; 0.272)
		Metal Processing Industry and Agricultural	0.145 (0.119 ; 0.171)
		Coal and Oil Combustion, and Biomass Burning	-0.187 (-0.205 ; -0.169)
		Motor Vehicle	0.771 (0.73 ; 0.813)
	% non-Hispanic Black	PM _{2.5}	0.084 (0.073 ; 0.095)
		Soil and Crustal Dust	-0.046 (-0.068 ; -0.024)
		Heavy Fuel Oil and Industrial	0.227 (0.192 ; 0.261)
		Metal Processing Industry and Agricultural	0.041 (0.02 ; 0.062)
		Coal and Oil Combustion, and Biomass Burning	-0.004 (-0.019 ; 0.01)
		Motor Vehicle	0.308 (0.273 ; 0.342)
Northeast	% Below Poverty Line	PM _{2.5}	0.112 (0.053 ; 0.17)
		Soil and Crustal Dust	0.016 (-0.013 ; 0.045)
		Heavy Fuel Oil and Industrial	0.866 (0.611 ; 1.12)
		Metal Processing Industry and Agricultural	0.649 (0.519 ; 0.779)
		Coal and Oil Combustion, and Biomass Burning	-0.201 (-0.257 ; -0.145)
		Motor Vehicle	0.167 (0.061 ; 0.273)
	% No High School	PM _{2.5}	0.243 (0.175 ; 0.311)
		Soil and Crustal Dust	-0.078 (-0.112 ; -0.045)
		Heavy Fuel Oil and Industrial	1.479 (1.184 ; 1.773)
		Metal Processing Industry and Agricultural	0.121 (-0.033 ; 0.275)
		Coal and Oil Combustion, and Biomass Burning	-0.014 (-0.08 ; 0.051)
		Motor Vehicle	-0.446 (-0.568 ; -0.324)
	% Renters	PM _{2.5}	0.11 (0.082 ; 0.137)
		Soil and Crustal Dust	-0.067 (-0.081 ; -0.053)
		Heavy Fuel Oil and Industrial	1.377 (1.265 ; 1.49)
		Metal Processing Industry and Agricultural	0.361 (0.3 ; 0.423)
		Coal and Oil Combustion, and Biomass Burning	-0.323 (-0.348 ; -0.299)
		Motor Vehicle	0.499 (0.452 ; 0.547)

Region	Predictor	Source category	Estimate (95%CI)
	% non-Hispanic Black	PM _{2.5}	0.073 (0.034 ; 0.112)
		Soil and Crustal Dust	0.004 (-0.015 ; 0.023)
		Heavy Fuel Oil and Industrial	0.821 (0.653 ; 0.989)
		Metal Processing Industry and Agricultural	0.192 (0.104 ; 0.28)
		Coal and Oil Combustion, and Biomass Burning	-0.149 (-0.186 ; -0.112)
		Motor Vehicle	0.335 (0.266 ; 0.404)
Midwest	% Below Poverty Line	PM _{2.5}	0.045 (0.013 ; 0.076)
		Soil and Crustal Dust	0.319 (0.287 ; 0.352)
		Heavy Fuel Oil and Industrial	0.014 (-0.019 ; 0.047)
		Metal Processing Industry and Agricultural	0.366 (0.292 ; 0.439)
		Coal and Oil Combustion, and Biomass Burning	-0.186 (-0.222 ; -0.151)
		Motor Vehicle	1.056 (0.985 ; 1.128)
	% No High School	PM _{2.5}	0.099 (0.06 ; 0.138)
		Soil and Crustal Dust	0.317 (0.276 ; 0.357)
		Heavy Fuel Oil and Industrial	-0.077 (-0.118 ; -0.036)
		Metal Processing Industry and Agricultural	0.543 (0.452 ; 0.633)
		Coal and Oil Combustion, and Biomass Burning	-0.089 (-0.133 ; -0.045)
		Motor Vehicle	1.057 (0.967 ; 1.147)
	% Renters	PM _{2.5}	0.097 (0.079 ; 0.115)
		Soil and Crustal Dust	0.151 (0.133 ; 0.17)
		Heavy Fuel Oil and Industrial	0.06 (0.041 ; 0.079)
		Metal Processing Industry and Agricultural	0.408 (0.367 ; 0.449)
		Coal and Oil Combustion, and Biomass Burning	-0.177 (-0.197 ; -0.157)
		Motor Vehicle	0.733 (0.693 ; 0.773)
% non-Hispanic Black	PM _{2.5}	0.11 (0.091 ; 0.129)	
	Soil and Crustal Dust	0.115 (0.095 ; 0.135)	
	Heavy Fuel Oil and Industrial	0.119 (0.099 ; 0.139)	
	Metal Processing Industry and Agricultural	0.549 (0.506 ; 0.592)	
	Coal and Oil Combustion, and Biomass Burning	-0.239 (-0.26 ; -0.219)	
	Motor Vehicle	0.733 (0.691 ; 0.776)	

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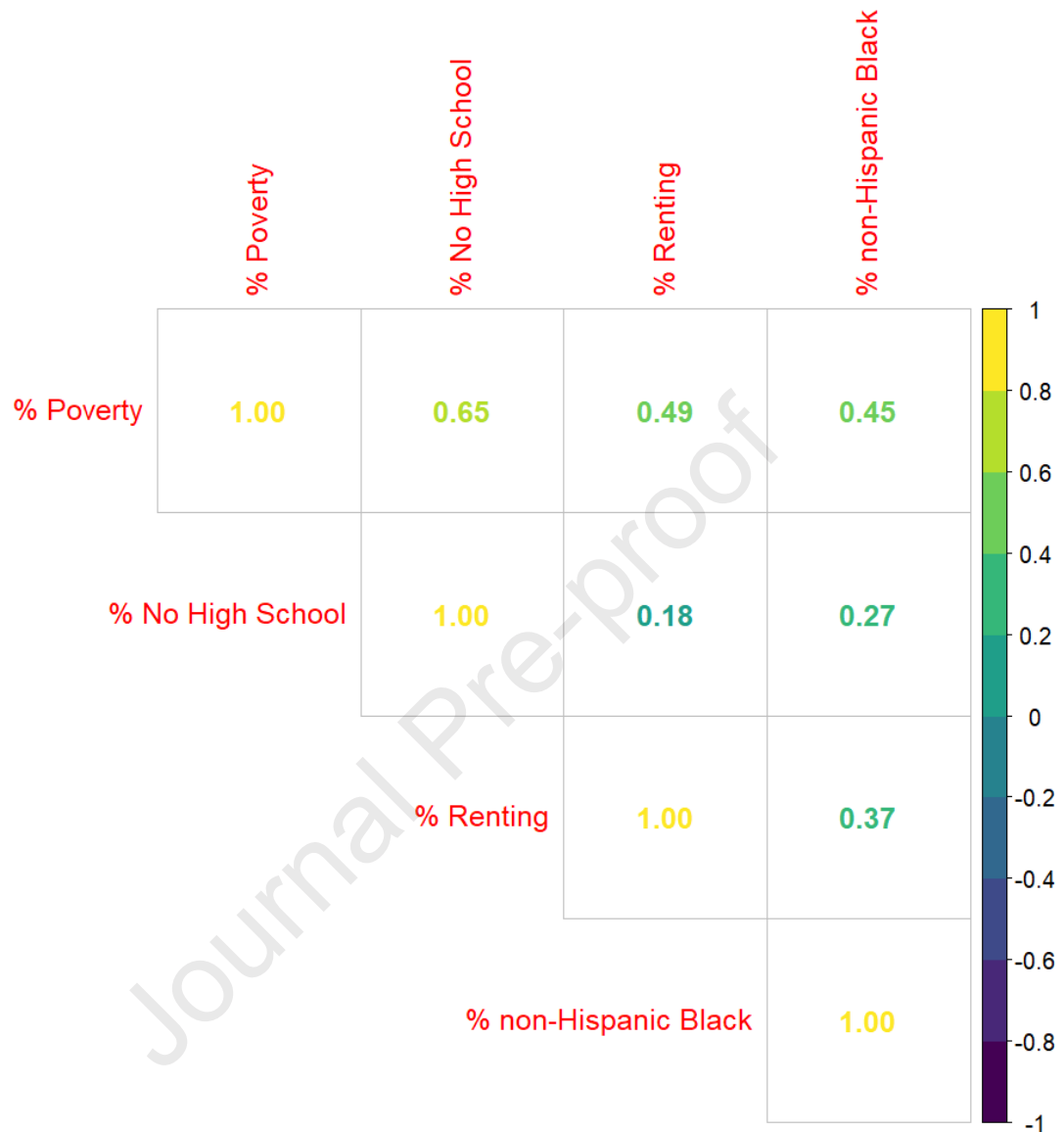
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483 **Supplementary Table 4:** estimates for multiple-exposures models. We fit generalized nonlinear
 484 models including ZIP zip code characteristic to assess the associations with each source
 485 category. Estimates are associated with a 10% change in the predictors. We adjusted for
 486 population density, RUCA, % population over 65, and % population female.
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Source category - Model	Predictor	Estimate (95%CI)
PM _{2.5}	% Below Poverty Line	-0.252 (-0.284 ; -0.221)
	% No High School	0.277 (0.251 ; 0.303)
	% Renters	0.149 (0.135 ; 0.163)
	% non-Hispanic Black	0.048 (0.035 ; 0.061)
Soil and Crustal Dust	% Below Poverty Line	0.366 (0.323 ; 0.41)
	% No High School	0.403 (0.367 ; 0.439)
	% Renters	-0.041 (-0.06 ; -0.022)
	% non-Hispanic Black	-0.154 (-0.172 ; -0.136)
Heavy Fuel Oil and Industrial	% Below Poverty Line	-0.692 (-0.777 ; -0.606)
	% No High School	0.293 (0.222 ; 0.364)
	% Renters	0.644 (0.607 ; 0.681)
	% non-Hispanic Black	0.233 (0.198 ; 0.268)
Metal Processing Industry and Agricultural	% Below Poverty Line	-0.284 (-0.339 ; -0.229)
	% No High School	0.234 (0.188 ; 0.28)
	% Renters	0.248 (0.224 ; 0.272)
	% non-Hispanic Black	0.113 (0.09 ; 0.136)
Coal and Oil Combustion, and Biomass Burning	% Below Poverty Line	0.043 (0.014 ; 0.072)
	% No High School	0.031 (0.007 ; 0.055)
	% Renters	-0.21 (-0.223 ; -0.197)
	% non-Hispanic Black	-0.031 (-0.043 ; -0.019)
Motor Vehicle	% Below Poverty Line	-0.252 (-0.325 ; -0.18)
	% No High School	0.388 (0.328 ; 0.449)
	% Renters	0.689 (0.657 ; 0.721)
	% non-Hispanic Black	0.144 (0.115 ; 0.174)

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489 **Supplementary Figure 1:** Correlation plot of zip code characteristics.



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Supplementary Figure 2: Map of the spatial distribution of the Soil and Crustal Dust source category.

Supplementary Figure 3: Map of the spatial distribution of the Metal Processing Industry and Agricultural source category.

Supplementary Figure 4: Map of the spatial distribution of the Heavy Fuel Oil and Industrial source category.

Supplementary Figure 5: Map of the spatial distribution of the Coal and Oil Combustion, and Biomass Burning.

Supplementary Figure 6: Map of the spatial distribution of the Motor Vehicle source category.