

Supplemental Material

Table S1 Main results on the associations between exposure to PM_{2.5} and concentrations of Alzheimer's disease (AD) Cerebrospinal fluid (CSF) biomarkers

Air Pollutant	AD CSF Biomarker	N	Beta	95% CI	P-value
1-year Ambient PM_{2.5}	Aβ₄₂	1113	-0.09	(-0.15; -0.02)	0.01
	pTau	1113	-0.05	(-0.12; 0.01)	0.11
	tTau	1113	-0.05	(-0.12; 0.01)	0.11
	pTau/A β ₄₂	1113	0.05	(-0.02; 0.11)	0.18
	tTau/A β ₄₂	1113	0.05	(-0.02; 0.11)	0.16
3-year Ambient PM_{2.5}	Aβ₄₂	1113	-0.07	(-0.13; -0.01)	0.03
	pTau	1113	-0.06	(-0.11; 0.003)	0.06
	tTau	1113	-0.06	(-0.12; 0.001)	0.047
	pTau/A β ₄₂	1113	0.02	(-0.05; 0.08)	0.62
	tTau/A β ₄₂	1113	0.02	(-0.04; 0.08)	0.59
5-year Ambient PM_{2.5}	Aβ₄₂	1113	-0.07	(-0.13; 0.004)	0.07
	pTau	1113	-0.05	(-0.12; 0.02)	0.14
	tTau	1113	-0.06	(-0.12; 0.01)	0.10
	pTau/A β ₄₂	1113	0.02	(-0.05; 0.09)	0.57
	tTau/A β ₄₂	1113	0.02	(-0.05; 0.09)	0.55
1-year Traffic- related PM_{2.5}	Aβ₄₂	1080	-0.03	(-0.10; 0.03)	0.33
	pTau	1080	0.01	(-0.06; 0.8)	0.77
	tTau	1080	0.01	(-0.06; 0.07)	0.86
	pTau/A β ₄₂	1080	0.04	(-0.03; 0.11)	0.25
	tTau/A β ₄₂	1080	0.05	(-0.02; 0.11)	0.20
3-year Traffic- related PM_{2.5}	Aβ₄₂	1080	-0.06	(-0.13; 0.01)	0.12
	pTau	1080	0.002	(-0.07; 0.07)	0.96
	tTau	1080	-0.004	(-0.07; 0.06)	0.91
	pTau/A β ₄₂	1080	0.05	(-0.02; 0.12)	0.14
	tTau/A β ₄₂	1080	0.06	(-0.01; 0.13)	0.11
5-year Traffic- related PM_{2.5}	Aβ₄₂	1080	-0.06	(-0.14; 0.01)	0.10
	pTau	1080	0.01	(-0.07; 0.08)	0.90
	tTau	1080	-0.0003	(-0.07; 0.07)	0.99
	pTau/A β ₄₂	1080	0.06	(-0.01; 0.14)	0.09
	tTau/A β ₄₂	1080	0.07	(-0.01; 0.14)	0.07

Associations were adjusted by sex, age, educational attainment, ethnic group, BMI, and neighborhood SES. Standardized coefficients are reported. Significant associations (p<0.05) are indicated in bold.

Table S2 Main results on the associations between exposure to PM_{2.5} and AD positive (+) cut-offs for AD CSF biomarkers

Air Pollutant	AD CSF (+) cut-offs	N	Odds Ratio	95% CI	P-value
1-year Ambient PM _{2.5}	A β ₄₂	1113	1.23	(1.07; 1.42)	0.004
	pTau	1113	0.11	(0.82; 1.42)	0.59
	tTau	1113	0.92	(0.70; 1.20)	0.52
	pTau/A β ₄₂	1113	1.15	(0.93; 1.43)	0.20
	tTau/A β ₄₂	1113	1.20	(0.94; 1.55)	0.13
3-year Ambient PM _{2.5}	A β ₄₂	1113	1.20	(1.04; 1.37)	0.009
	pTau	1113	1.01	(0.78; 1.39)	0.65
	tTau	1113	0.92	(0.71; 1.17)	0.48
	pTau/A β ₄₂	1113	1.09	(0.89; 1.33)	0.43
	tTau/A β ₄₂	1113	1.13	(0.89; 1.42)	0.31
5-year Ambient PM _{2.5}	A β ₄₂	1113	1.21	(1.04; 1.40)	0.01
	pTau	1113	1.07	(0.80; 1.43)	0.65
	tTau	1113	0.95	(0.71; 1.26)	0.71
	pTau/A β ₄₂	1113	1.11	(0.89; 1.40)	0.36
	tTau/A β ₄₂	1113	1.21	(0.93; 1.58)	0.16
1-year Traffic-related PM _{2.5}	A β ₄₂	1080	1.10	(0.95; 1.27)	0.22
	pTau	1080	0.97	(0.58; 1.60)	0.89
	tTau	1080	1.02	(0.75; 1.38)	0.89
	pTau/A β ₄₂	1080	1.35	(0.94; 1.94)	0.10
	tTau/A β ₄₂	1080	1.26	(0.84; 1.90)	0.27
3-year Traffic-related PM _{2.5}	A β ₄₂	1080	1.14	(0.98; 1.32)	0.10
	pTau	1080	0.95	(0.56; 1.62)	0.85
	tTau	1080	0.98	(0.71; 1.34)	0.88
	pTau/A β ₄₂	1080	1.52	(1.05; 2.20)	0.03
	tTau/A β ₄₂	1080	1.41	(0.93; 2.15)	0.11
5-year Traffic-related PM _{2.5}	A β ₄₂	1080	1.15	(0.98; 1.35)	0.08
	pTau	1080	0.98	(0.56; 1.70)	0.95
	tTau	1080	0.10	(0.71; 1.40)	0.10
	pTau/A β ₄₂	1080	1.56	(1.06; 2.28)	0.02
	tTau/A β ₄₂	1080	1.44	(0.93; 2.22)	0.10

Associations were adjusted by sex, age, educational attainment, ethnic group, BMI, and neighborhood SES. Significant associations (p<0.05) are indicated in bold.

Table S3 Results on the associations between exposure to Ambient PM_{2.5} and concentrations of Alzheimer's disease (AD) Cerebrospinal fluid (CSF) biomarkers (linear: continuous biomarker concentrations; logistic: AD CSF cut-offs) for participants with traffic-related exposure, located in the metro-Atlanta area (N=1080)

Air Pollutant	AD CSF Biomarker	N	Beta	95% CI	P-value
1-year Ambient PM_{2.5}	A β ₄₂	1080	-0.09	(-0.16; -0.02)	0.01
	pTau	1080	-0.06	(-0.13; 0.01)	0.10
	tTau	1080	-0.06	(-0.12; 0.01)	0.10
	pTau/A β ₄₂	1080	0.05	(-0.02; 0.12)	0.17
	tTau/A β ₄₂	1080	0.05	(-0.02; 0.12)	0.16
3-year Ambient PM_{2.5}	A β ₄₂	1080	-0.07	(-0.13; -0.004)	0.04
	pTau	1080	-0.07	(-0.13; -0.003)	0.04
	tTau	1080	-0.07	(-0.13; -0.01)	0.03
	pTau/A β ₄₂	1080	0.05	(-0.02; 0.11)	0.12
	tTau/A β ₄₂	1080	0.01	(-0.05; 0.08)	0.67
5-year Ambient PM_{2.5}	A β ₄₂	1080	-0.07	(-0.14; -0.01)	0.08
	pTau	1080	-0.06	(-0.13; 0.01)	0.10
	tTau	1080	-0.07	(-0.14; 0.01)	0.07
	pTau/A β ₄₂	1080	0.02	(-0.06; 0.09)	0.66
	tTau/A β ₄₂	1080	0.02	(-0.06; 0.09)	0.64
Air Pollutant	AD CSF Biomarker	N	Odds Ratio	95% CI	P-value
1-year Ambient PM_{2.5}	A β ₄₂	1080	1.24	(1.07; 1.44)	0.005
	pTau	1080	1.02	(0.76; 1.38)	0.88
	tTau	1080	0.80	(0.60; 1.07)	0.13
	pTau/A β ₄₂	1080	1.20	(0.95; 1.51)	0.12
	tTau/A β ₄₂	1080	1.28	(0.98; 1.68)	0.07
3-year Ambient PM_{2.5}	A β ₄₂	1080	1.20	(1.05; 1.39)	0.01
	pTau	1080	0.94	(0.71; 1.23)	0.63
	tTau	1080	0.81	(0.62; 1.06)	0.12
	pTau/A β ₄₂	1080	1.12	(0.90; 1.40)	0.30
	tTau/A β ₄₂	1080	1.18	(0.91; 1.53)	0.21
5-year Ambient PM_{2.5}	A β ₄₂	1080	1.20	(1.03; 1.41)	0.02
	pTau	1080	0.99	(0.73; 1.36)	0.97
	tTau	1080	0.82	(0.61; 1.11)	0.21
	pTau/A β ₄₂	1080	1.15	(0.90; 1.48)	0.26
	tTau/A β ₄₂	1080	1.27	(0.95; 1.70)	0.10

Associations were adjusted by sex, age, educational attainment, ethnic group, BMI, and neighborhood SES. Standardized coefficients are reported. Significant associations (p<0.05) are indicated in bold.

Table S4 Results on the associations between annual exposure to Ambient PM_{2.5} and concentrations of Alzheimer's disease (AD) Cerebrospinal fluid (CSF) biomarkers by common risk factors

Covariate	1-year Ambient PM _{2.5}	N	Interaction P-value
			0.59
APOE-e4 status			
Yes	-0.16 (-0.30; -0.02)	264	
No	-0.11 (-0.22; -0.01)	591	
Overall	-0.13 (-0.21; -0.04)	855	
			0.37
Family History of AD			
Yes	-0.16 (-0.32; -0.01)	252	
No	-0.09 (-0.18; 0.004)	861	
Overall	-0.10 (-0.18; -0.03)	1113	
			0.62
ADI			
≥50	-0.06 (-0.24, 0.12)	184	
<50	-0.11 (-0.20; -0.03)	929	
Overall	-0.10 (-0.18; -0.02)	1113	
			0.67
Sex			
Male	-0.13 (-0.26; 0.01)	338	
Female	-0.09 (-0.18; 0.004)	775	
Overall	-0.10 (-0.18; -0.02)	1113	

Table S5 Results (Odds Ratio $\pm$ 95% CI) on the associations between annual exposure to Ambient PM_{2.5} and concentrations of Alzheimer's disease (AD) Cerebrospinal fluid (CSF) biomarkers by common risk factors

Covariate	1-year Ambient PM _{2.5}	N	Interaction P-value
			0.80
APOE-e4 status			
Yes	1.48 (1.08; 2.02)	264	
No	1.40 (1.08; 1.80)	591	
Overall	1.43 (1.17; 1.74)	855	
			0.27
Family History of AD			
Yes	1.51 (1.08; 2.09)	252	
No	1.21 (1.00; 1.48)	861	
Overall	1.29 (1.09; 1.53)	1113	
			0.12
ADI			
≥ 50	0.96 (0.64; 1.43)	184	
< 50	1.36 (1.13; 1.64)	929	
Overall	1.28 (1.08; 1.52)	1113	
			0.72
Sex			
Male	1.34 (1.00; 1.79)	338	
Female	1.25 (1.02; 1.79)	775	
Overall	1.28 (1.08; 1.52)	1113	

Table S6 Neighborhood-level characteristics used in the construction of neighborhood deprivation principal components

Potential confounder Neighborhood-level Characteristics	Overall (N=1113)
edu_less_highschool	
Mean (SD)	8.07 (7.23)
unemploy_rate	
Mean (SD)	7.38 (4.50)
not_in_laborforce	
Mean (SD)	24.8 (8.17)
vacant	
Mean (SD)	9.22 (5.96)
rented	
Mean (SD)	31.9 (20.8)
crowded	
Mean (SD)	1.62 (2.15)
median_value	
Mean (SD)	268000 (154000)
male_not_manage	
Mean (SD)	52.7 (18.8)
female_not_manage	
Mean (SD)	48.7 (14.7)
in_poverty	
Mean (SD)	8.53 (7.84)
female_headed	
Mean (SD)	6.17 (4.59)
income_less_35000	
Mean (SD)	24.0 (12.4)
public_assist	
Mean (SD)	1.31 (1.45)
no_car	

Mean (SD)	13.7 (15.9)
non_hispanic_black	
Mean (SD)	22.9 (24.4)
hispanic	
Mean (SD)	8.51 (9.41)

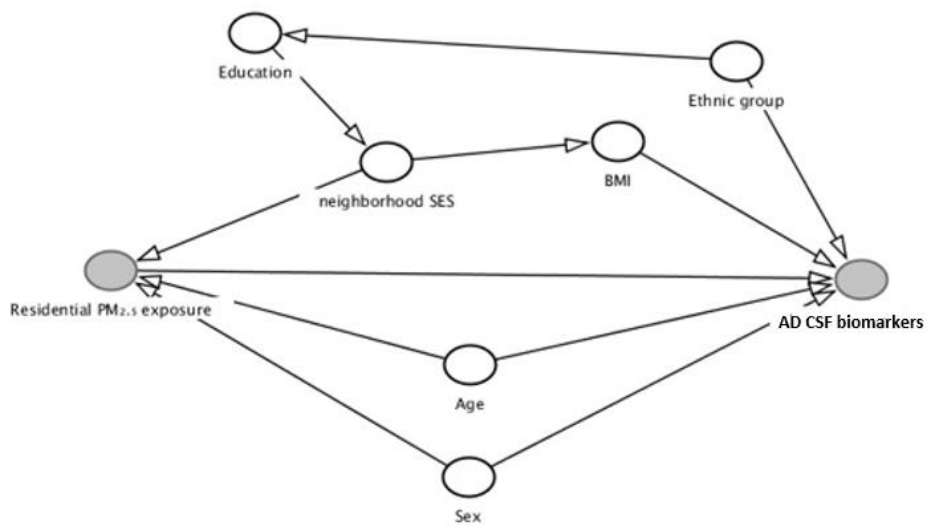


Figure S1 Directed Acyclic Graph (DAG) connecting PM_{2.5} to AD CSF biomarkers and defining potential confounding factors. PM_{2.5}, fine particulate matter; AD; Alzheimer's disease; CSF, cerebrospinal fluid; BMI, body mass index; SES, socioeconomic status

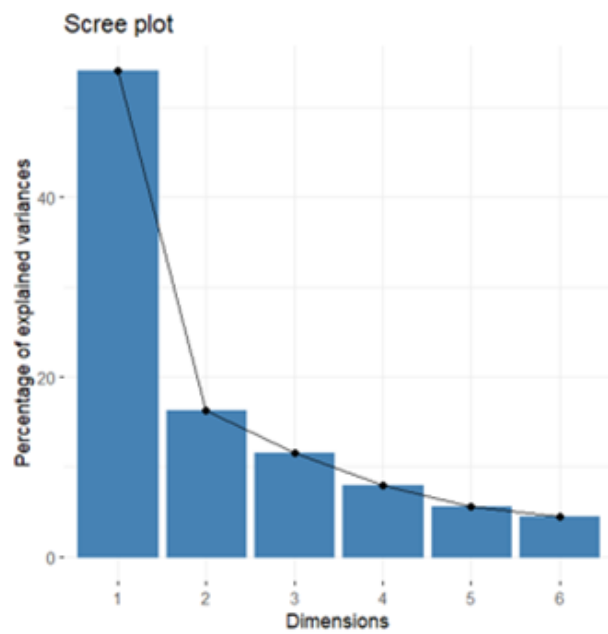


Figure S2 Elbow method and results for computing neighborhood deprivation indicators.

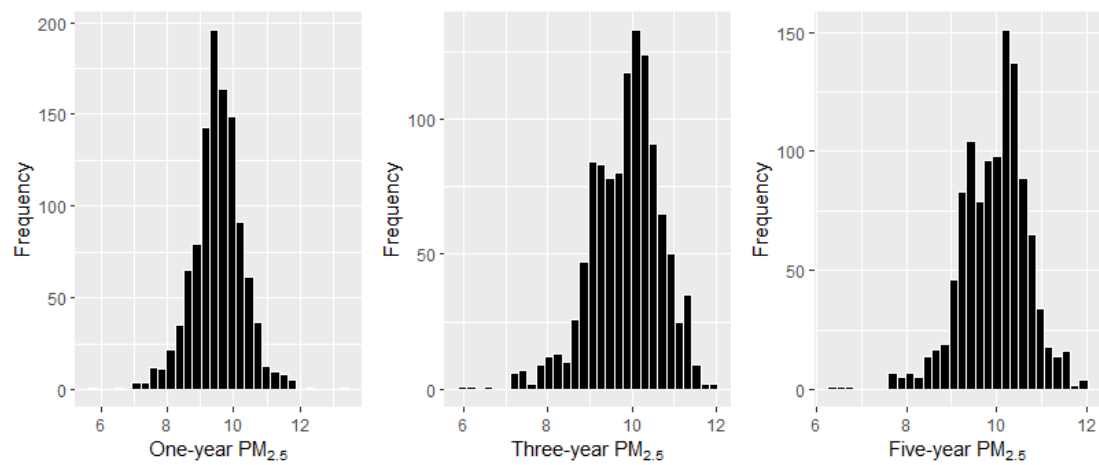


Figure S3 Histograms of 1, 3, and 5-year ambient PM_{2.5} exposure concentrations (in µg/m³).

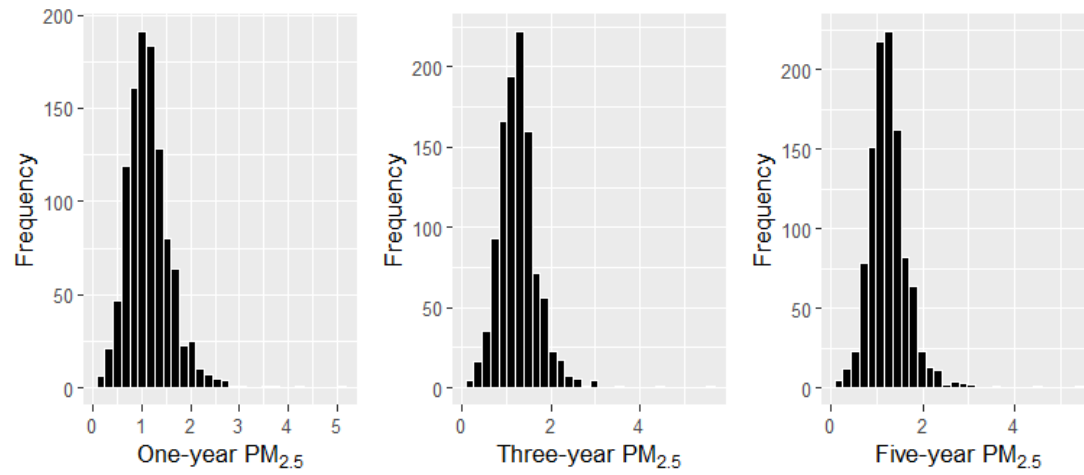


Figure S4 Histograms of 1, 3, and 5-year traffic-related PM_{2.5} exposure concentrations (in µg/m³).

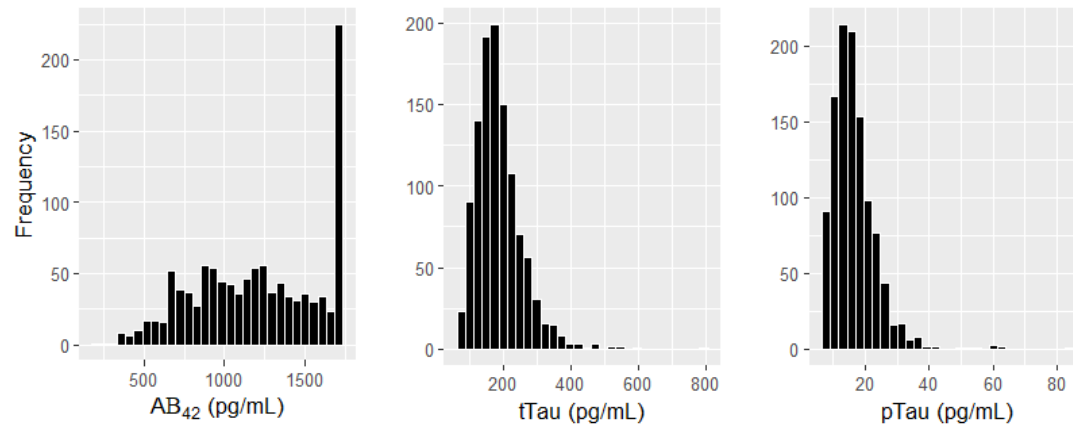


Figure S5 Histograms of Aβ₄₂, tTau, and pTau concentrations (in pg/mL) collected at baseline (2016-2020) before log transformation.

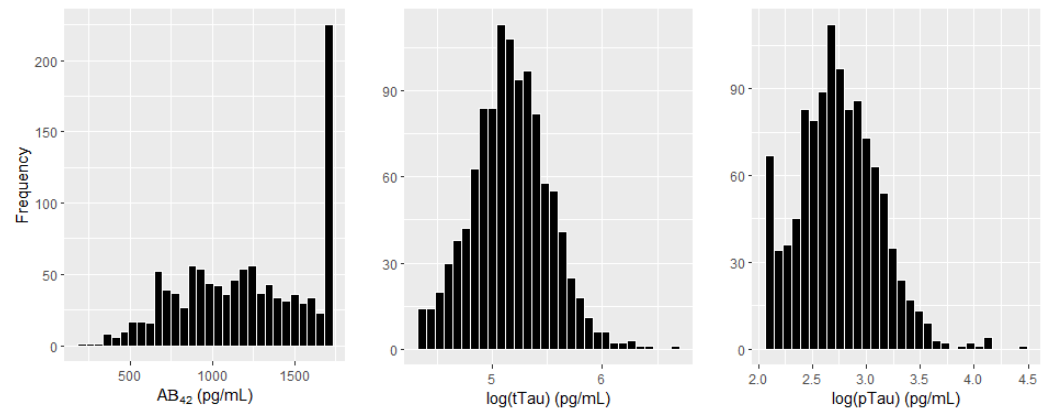


Figure S6 Histograms of $A\beta_{42}$, tTau, and pTau concentrations (in pg/mL) collected at baseline (2016-2020) after log transformation.

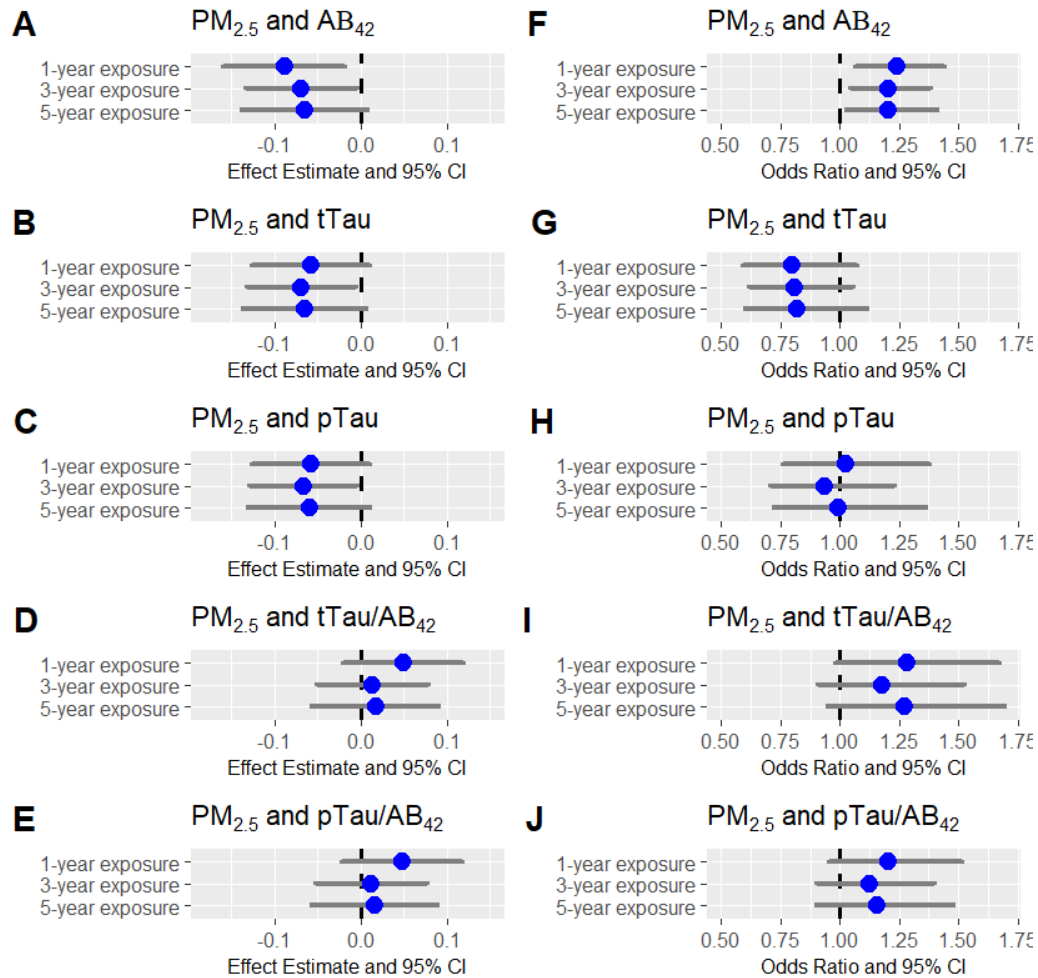


Figure S7 Effect Estimate ($\pm$ 95% CI) **A–E** and Odds ratio ($\pm$ 95% CI) **F–J** for the association between 1, 3, and 5-year ambient $PM_{2.5}$ exposure and AD CSF Biomarker ($A\beta_{42}$, tTau, pTau, tTau/ $A\beta_{42}$, and pTau/ $A\beta_{42}$) concentrations or AD positive (+) cut-offs. Sample size (**N=1080**) represents the subset of EHBS participants with available traffic-related $PM_{2.5}$ exposure at the residence. All estimates are standardized and adjusted for sex, age, N-SES, ethnicity, educational attainment, and BMI. The dashed line indicates the significance threshold: 0 for linear regression and 1 for logistic regression.

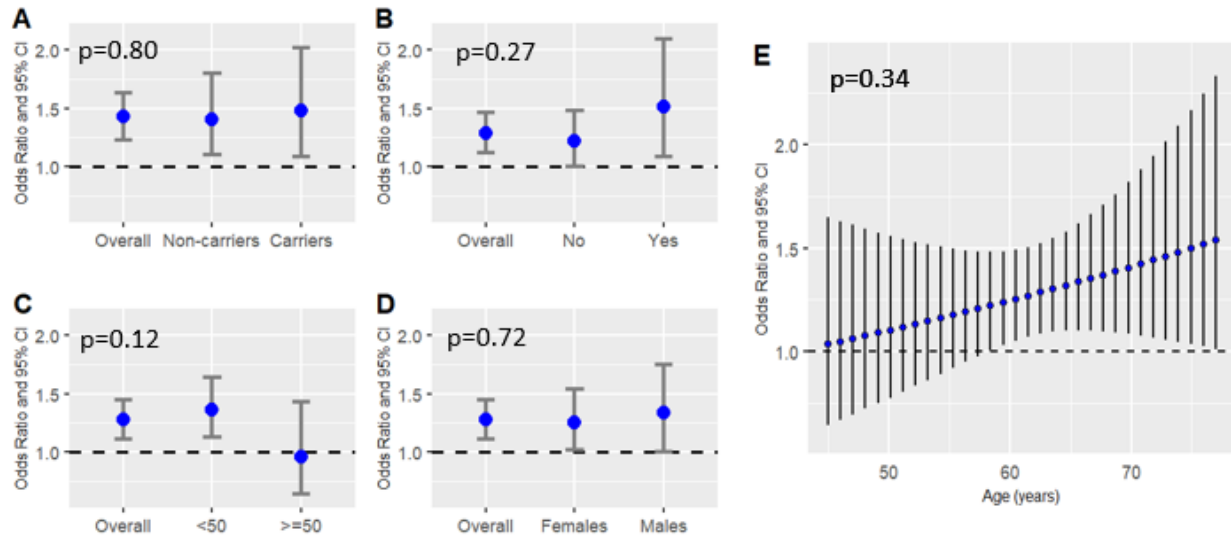


Figure S8 Odds Ratio (± 95% CI) for the association between yearly ambient PM_{2.5} exposure and Aβ₄₂ AD CSF Biomarkers positive (+) cut-offs by *APOE*-ε4 carriership (**A**), AD family history (**B**), ADI (**C**), Sex (**D**), and Age (**E**). Presented as overall and stratified effects for dichotomous variables and as continuous for Age, with interaction p-values depicted on each graph. The dashed line indicates the significance threshold: 1 for logistic regression. The overall effect in **Figure S8A** (N=855) differs slightly from **Figure S8B-D** (N=1113) due to the decreased sample size after including only participants with *APOE* genotype data.