Supplemental Material

Ambient Air Pollution and Long-Term Trajectories of Episodic Memory Decline among Older Women in the WHIMS-ECHO Cohort

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Table S1. Distribution of air pollution exposure and population characteristics in the WHIMS-ECHO cohort included vs. excluded, mean ± SD or n(%). All characteristics classified at WHI inception (1993–1998) unless otherwise indicated.

Characteristics	N non-missing	ECHO cohort[a] (n=2880)	Included (n=2056)	Excluded[a] (n=824)	p-value
Air Pollution[b] Exposures:					
Remote $PM_{2.5}$ ($\mu g/m^3$)	2782	13.35 ± 2.72	13.29 ± 2.71	13.52 ± 2.76	0.04
Recent $PM_{2.5}$ ($\mu g/m^3$)	2847	10.59 ± 2.02	10.52 ± 2.01	10.78 ± 2.03	0.002
Remote NO_2 (ppb)	2782	15.91 ± 7.30	15.82 ± 7.26	16.15 ± 7.41	0.29
Recent NO_2 (ppb)	2847	10.62 ± 5.09	10.47 ± 4.98	11.00 ± 5.33	0.01
Age at WHIMS-ECHO enrollment (years)	2880	81.77 ± 3.61	81.51 ± 3.52	82.42 ± 3.75	<0.001
Neighborhood SES[c]					
At WHI inception	2755	0.44 ± 5.31	0.59 ± 5.26	0.00 ± 5.43	0.01
At WHIMS-ECHO enrollment	2879	0.00 ± 5.16	0.12 ± 5.11	-0.31 ± 5.27	0.04
Region					<0.001
Northeast		872 (30.3)	662 (32.2)	210 (25.5)	
South		625 (21.7)	408 (19.8)	217 (26.3)	
Midwest		684 (23.8)	498 (24.2)	186 (22.6)	
West		699 (24.3)	488 (23.7)	211 (25.6)	
Race/Ethnicity					<0.001
American Indian or Alaskan Native		6 (0.2)	4 (0.2)	2 (0.2)	
Asian or Pacific Islander		42 (1.5)	17 (0.8)	25 (3.0)	
Black, non-Hispanic		180 (6.3)	107 (5.2)	73 (8.9)	
Hispanic/Latino		47 (1.6)	29 (1.4)	18 (2.2)	
White, non-Hispanic		2559 (88.9)	1875 (91.2)	684 (83.0)	
Other[d]		43 (1.5)	23 (1.1)	20 (2.4)	
Missing		3 (0.1)	1 (0.1)	2 (0.2)	
Education					<0.001
≤High school or GED		742 (25.8)	500 (24.3)	242 (29.6)	
>High school <4 years of college		1139 (39.6)	789 (38.4)	350 (42.7)	
≥4 years of college		994 (34.6)	767 (37.3)	227 (27.7)	
Employment					0.41
Currently working		433 (15.1)	321 (15.6)	112 (13.7)	
Not working		270 (9.4)	195 (9.5)	75 (9.2)	
Retired		2168 (75.5)	1540 (74.9)	628 (77.1)	
Income ($)					<0.001
<9,999		112 (3.9)	68 (3.3)	44 (5.3)	
10,000-34,999		1307 (45.4)	906 (44.1)	401 (48.7)	
35,000-49,999		628 (21.8)	450 (21.9)	178 (21.6)	
50,000-74,999		420 (14.6)	321 (15.6)	99 (12.0)	
≥75,000		264 (9.2)	212 (10.3)	52 (6.3)	
Don't know		149 (5.2)	99 (4.8)	50 (6.1)	
Smoking status					0.44
Never smoked		1572 (55.1)	1138 (55.4)	434 (54.6)	
Past smoker		1138 (39.9)	823 (40.0)	315 (39.6)	
Current Smoker		141 (4.9)	95 (4.6)	46 (5.8)	
Alcohol use					0.07
Non-drinker		351 (12.3)	243 (11.8)	108 (13.4)	
Past drinker		503 (17.6)	342 (16.6)	161 (20.0)	
<1 drink per day		1643 (57.5)	1204 (58.6)	439 (54.7)	

≥1 drink per day		362 (12.7)	267 (13)	95 (11.8)	
Physical activity[e]					0.25
No activity		1584 (55.1)	1109 (53.9)	475 (57.9)	
Some activity		152 (5.3)	114 (5.5)	38 (4.6)	
2-4 episodes/week		597 (20.8)	439 (21.4)	158 (19.3)	
>4 episodes/week		543 (18.9)	394 (19.2)	149 (18.2)	
Hypercholesterolemia					0.01
No		2336 (82.3)	1716 (83.5)	620 (79.4)	
Yes		501 (17.7)	340 (16.5)	161 (20.6)	
Diabetes					0.08
No		2753 (95.7)	1976 (96.1)	777 (94.6)	
Yes		124 (4.3)	80 (3.9)	44 (5.4)	
Hormone treatment					0.91
No		1580 (54.9)	1127 (54.8)	453 (55.0)	
Yes		1299 (45.1)	929 (45.2)	370 (45.0)	
Hypertension					
At WHI inception					0.24
No		1865 (65.3)	1357 (66.0)	508 (63.7)	
Yes		989 (34.7)	699 (34.0)	290 (36.3)	
At WHIMS-ECHO enrollment					0.08
No		919 (31.9)	676 (32.9)	243 (29.5)	
Yes		1961 (68.1)	1380 (67.1)	581 (70.5)	
Cardiovascular disease history					
At WHI inception					0.88
No		2434 (85.6)	1759 (85.6)	675 (85.8)	
Yes		409 (14.4)	297 (14.4)	112 (14.2)	
At WHIMS-ECHO enrollment					0.14
No		2171 (76.3)	1583 (77.0)	588 (74.3)	
Yes		676 (23.7)	473 (23.0)	203 (25.7)	
WHI Hormone Therapy Assignment					0.61
Estrogen-alone control		531 (18.4)	375 (18.2)	156 (18.9)	
Estrogen-alone intervention		521 (18.1)	362 (17.6)	159 (19.3)	
Estrogen+Progestin control		947 (32.9)	688 (33.5)	259 (31.4)	
Estrogen+Progestin intervention		881 (30.6)	631 (30.7)	250 (30.3)	

All covariates were assessed at WHI inception unless otherwise noted. All p-values were calculated using t-test for continuous variables, Fisher's exact test for race/ethnicity, or chi-square test for other categorical variables.

[a] Numbers in the WHIMS-ECHO cohort or the excluded population may not add up to total due to missing.

[b] Recent exposures were 3-year average exposures estimated at the WHIMS-ECHO enrollment. Remote exposures were 3-year average exposures estimated 10 years before the WHIMS-ECHO enrollment.

[c] Neighborhood SES is the sum of six standardized U.S. Census tract-level variables measuring domains of wealth/income, education, and occupation. Higher values indicate higher neighborhood socioeconomic status.

[d] "Other" race/ethnicity includes women who did not select one of the 5 specific race/ethnicity groups.

[e] Moderate or strenuous physical activities ≥20 minutes

Table S2. Pearson correlations[a] between remote and recent $PM_{2.5}$ and NO_2 exposures[b].

	Aged ≤80 years (N=828)				Aged >80 years (N=1228)			
	Remote $PM_{2.5}$	Recent $PM_{2.5}$	Remote NO_2	Recent NO_2	Remote $PM_{2.5}$	Recent $PM_{2.5}$	Remote NO_2	Recent NO_2
Remote $PM_{2.5}$	1				1			
Recent $PM_{2.5}$	0.80	1			0.80	1		
Remote NO_2	0.60	0.38	1		0.65	0.46	1	
Recent NO_2	0.56	0.45	0.91	1	0.57	0.51	0.90	1

[a]all p-values < 0.001
[b]remote $PM_{2.5}$: 3-year average of $PM_{2.5}$ 10 years before the WHIMS-ECHO enrollment ($\mu g/m^3$)
recent $PM_{2.5}$: 3-year average of $PM_{2.5}$ at the WHIMS-ECHO enrollment ($\mu g/m^3$)
remote NO_2: 3-year average of NO_2 10 years before the WHIMS-ECHO enrollment (ppb)
recent NO_2: 3-year average of NO_2 at the WHIMS-ECHO enrollment (ppb)

Table S3. Model fit statistics of the latent class mixture models, stratified by baseline age (≤80 vs. >80).[a]

Age group	Number of classes estimated	-2LL[b]	Parameters[c]	BIC	Class membership	Mean posterior probabilities
≤80 years	One	-12871	5	25777	Class 1 = 100%	Class 1 = 1.00
≤80 years	Two	-12791	9	25642	Class 1 = 77.7%, Class 2 = 22.3%	Class 1 = 0.85, Class 2 = 0.75
≤80 years	Three	-12779	13	25646	Class 1 = 64.3%, Class 2 = 4.1%, Class 3 = 31.6%	Class 1 = 0.79, Class 2 = 0.69, Class 3 = 0.66
≤80 years	Four	-12776	17	25666	Class 1 = 63.3%, Class 2 = 24.4%, Class 3 = 8.8%, Class 4 = 3.5%	Class 1 = 0.78, Class 2 = 0.62, Class 3 = 0.52, Class 4 = 0.66
>80 years	One	-16956	5	33947	Class 1 = 100%	Class 1 = 1.00
>80 years	Two	-16855	9	33774	Class 1 = 28.6%, Class 2 = 71.4%	Class 1 = 0.78, Class 2 = 0.75
>80 years	Three	-16838	13	33769	Class 1 = 74.8%, Class 2 = 2.3%, Class 3 = 22.9%	Class 1 = 0.72, Class 2 = 0.81, Class 3 = 0.71
>80 years	Four	-16832	17	33784	Class 1 = 57.2%, Class 2 = 39.7%, Class 3 = 1.5%, Class 4 = 1.5%	Class 1 = 0.64, Class 2 = 0.69, Class 3 = 0.72, Class 4 = 0.85

Abbreviations: BIC, Bayesian Information Criterion; WHIMS-ECHO, Women's Health Initiative Memory Study-Epidemiology of Cognitive Health Outcomes

[a]All models include age at WHIMS-ECHO enrollment and follow-up time as independent variables.

[b]-2LL = negative log likelihood from respective model

[c]Parameters = number of parameters in each respective model, including 2 parameters for the link function (intercept and standard error of linear transformation) used for the CVLT outcome, 1 parameter for the variance of random-effect of intercept specified, 2*ng parameters for the class-specific estimates of the two covariates included, (ng-1) parameters for intercepts estimated from the latent class membership model, and (ng-1) parameters for intercepts estimated from the longitudinal model. Here, ng=number of latent classes specified in LCMM.

Table S4. Summary of global associations between air pollution exposure and episodic memory decline from LCMM with 2-latent classes specified, stratified by age and exposure time-windows.

	PM$_{2.5}$ Effect Estimates								NO$_2$ Effect Estimates							
	Recent Exposure[a]				Remote Exposure[a]				Recent Exposure[a]				Remote Exposure[a]			
	N	β[b]	(95% CI)	p	N	β[b]	(95% CI)	p	N	β[b]	(95% CI)	p	N	β[b]	(95% CI)	p
≤80 years																
Model 1[c]	828	-0.15	(-0.26, -0.03)	0.01	828	-0.08	(-0.17, 0.01)	0.07	828	-0.01	(-0.11, 0.09)	0.83	828	0.02	(-0.09, 0.13)	0.74
Model 2[d]	828	-0.14	(-0.26, -0.03)	0.01	828	-0.08	(-0.18, 0.02)	0.12	828	-0.01	(-0.10, 0.08)	0.78	828	0.02	(-0.08, 0.11)	0.74
Excl. Dementia[e]	713	-0.14	(-0.24, -0.05)	0.003	–	–	–	–	713	-0.01	(-0.08, 0.07)	0.90	–	–	–	–
Excl. Stoke[f]	775	-0.13	(-0.23, -0.04)	0.005	–	–	–	–	775	-0.01	(-0.10, 0.07)	0.80	–	–	–	–
>80 years																
Model 1[c]	1228	-0.03	(-0.15, 0.09)	0.59	1228	0.04	(-0.05, 0.14)	0.40	1228	-0.09	(-0.20, 0.01)	0.08	1228	-0.03	(-0.14, 0.08)	0.62
Model 2[d]	1228	-0.04	(-0.16, 0.08)	0.51	1228	0.04	(-0.06, 0.14)	0.41	1228	-0.10	(-0.20, 0.01)	0.07	1228	-0.03	(-0.14, 0.08)	0.61
Excl. Dementia[e]	961	-0.07	(-0.15, 0.02)	0.15	–	–	–	–	961	-0.11	(-0.19, -0.03)	0.005	–	–	–	–
Excl. Stoke[f]	1120	-0.05	(-0.14, 0.03)	0.23	–	–	–	–	1120	-0.10	(-0.18, -0.02)	0.01	–	–	–	–

[a] Recent exposures were 3-year average exposures estimated at the WHIMS-ECHO enrollment. Remote exposures were 3-year average exposures estimated 10 years before the WHIMS-ECHO enrollment.
  recent 3-year PM$_{2.5}$: IQR = 2.88 µg/m^3
  remote 3-year PM$_{2.5}$: IQR = 3.27 µg/m^3
  recent 3-year NO$_2$: IQR = 6.25 ppb
  remote 3-year NO$_2$: IQR = 9.47 ppb
[b] β represents the average increase in CVLT score per year for each interquartile range (IQR) increase of 3-year average exposure. A negative β means higher air pollution exposure was associated with a greater decline in episodic memory.
[c] Model 1 was adjusted for age, follow-up time, age interaction with follow-up time, and time-varying propensity scores.
[d] Model 2 was adjusted for age, follow-up time, geographic region, self-reported race/ethnicity (where "other" includes women who reported they were American Indian or Alaskan Native, or Asian or Pacific Islander, or women who selected "other" instead of one of the five specific race/ethnicity categories, and women with missing data for race/ethnicity), SES (education, income, employment status, and neighborhood SES), lifestyle factors (smoking, drinking and physical activities), hormone treatment, cardiovascular risk factors (hypertension, diabetes and hypercholesterolemia), CVD histories, age interaction with follow-up time, and time-varying propensity scores.
[e] Excluding women with incident probable dementia during the follow up. Latent class memberships were assigned based on Model 2.
[f] Excluding women with either prevalent stroke or incident stroke during the follow up. Latent class memberships were assigned based on Model 2.

Table S5. Summary of sensitivity analyses for latent class-specific associations between air pollution exposure and episodic memory decline among women ≤80 years, stratified by exposure time-windows.

	$PM_{2.5}$ Effect Estimates								NO_2 Effect Estimates							
	Recent Exposure[a]				Remote Exposure[a]				Recent Exposure[a]				Remote Exposure[a]			
	N	β[b]	(95% CI)	p	N	β[b]	(95% CI)	p	N	β[b]	(95% CI)	p	N	β[b]	(95% CI)	p
Slow-decliners[c]																
Model 2[d] (main)	597	-0.16	(-0.28, -0.03)	0.01	596	-0.11	(-0.22, 0.01)	0.06	602	-0.004	(-0.19, 0.18)	0.97	612	0.003	(-0.15, 0.16)	0.97
Recent exposure IQR[e]	–	–	–	–	596	-0.09	(-0.19, 0.01)	0.06	–	–	–	–	612	0.002	(-0.10, 0.11)	0.97
Without PS[f]	601	-0.15	(-0.28, -0.03)	0.02	600	-0.10	(-0.22, 0.01)	0.07	598	-0.002	(-0.07, 0.07)	0.95	614	-0.01	(-0.12, 0.11)	0.93
With practice[g]	591	-0.16	(-0.28, -0.03)	0.01	593	-0.11	(-0.22, 0.01)	0.06	595	-0.01	(-0.10, 0.09)	0.92	606	-0.001	(-0.06, 0.05)	0.97
WHIMS-EHCO covariates[h]	596	-0.16	(-0.28, -0.03)	0.01	–	–	–	–	598	-0.004	(-0.12, 0.11)	0.94	–	–	–	–
Fast-decliners[c]																
Model 2[d] (main)	231	-0.06	(-0.32, 0.20)	0.64	232	0.06	(-0.19, 0.32)	0.62	226	-0.21	(-0.45, 0.04)	0.10	216	-0.04	(-0.33, 0.24)	0.76
Recent exposure IQR[e]	–	–	–	–	232	0.06	(-0.17, 0.28)	0.62	–	–	–	–	216	-0.03	(-0.22, 0.16)	0.76
Without PS[f]	227	-0.06	(-0.32, 0.20)	0.66	228	0.07	(-0.19, 0.32)	0.60	230	-0.21	(-0.45, 0.03)	0.09	214	-0.05	(-0.33, 0.22)	0.70
With practice[g]	237	-0.07	(-0.31, 0.18)	0.58	235	0.05	(-0.20, 0.30)	0.69	233	-0.21	(-0.46, 0.03)	0.08	222	-0.06	(-0.33, 0.21)	0.67
WHIMS-EHCO covariates[h]	232	-0.05	(-0.36, 0.26)	0.74	–	–	–	–	230	-0.21	(-0.45, 0.03)	0.09	–	–	–	–

Numbers of women within each latent class vary because women are assigned to the latent class with the highest probability according to each latent class mixed model.

[a]Recent exposures were 3-year average exposures estimated at the WHIMS-ECHO enrollment. Remote exposures were 3-year average exposures estimated 10 years before the WHIMS-ECHO enrollment.
    recent 3-year $PM_{2.5}$: IQR = 2.88 μg/m^3
    remote 3-year $PM_{2.5}$: IQR = 3.27 μg/m^3
    recent 3-year NO_2: IQR = 6.25 ppb
    remote 3-year NO_2: IQR = 9.47 ppb

[b]β represents the average increase in CVLT score per year for each interquartile range increase of 3-year average exposure. Negative β means greater air pollution exposure was associated with faster decline of episodic memory.
[c]Two latent trajectory subgroups were generated simultaneously from multivariate adjusted models in each scenario listed.
[d]Model 2 was adjusted for age, follow-up time, geographic region, self-reported race/ethnicity (where "other" includes women who reported they were American Indian or Alaskan Native, or Asian or Pacific Islander, or women who selected "other" instead of one of the five specific race/ethnicity categories, and women with missing data for race/ethnicity), SES (education, income, employment status, and neighborhood SES), lifestyle factors (smoking, drinking and physical activities), hormone treatment, cardiovascular risk factors (hypertension, diabetes and hypercholesterolemia), CVD histories, age interaction with follow-up time, and time-varying propensity scores.
[e]Model was adjusted for covariates in Model 2. Remote exposure was scaled by IQR of the corresponding recent exposure.
[f]Model was adjusted for covariates in Model 2, except for time-varying propensity scores.
[g]Model was adjusted for covariates in Model 2 and practice indicator.

Model was adjusted for covariates in Model 2, where neighborhood SES, hypertension, and CVD histories were assessed at the WHIMS-ECHO enrollment. Estimates were not reported for remote exposures as this sensitivity analysis was not applicable to remote exposures.

Table S6. Summary of sensitivity analyses for latent class-specific associations between air pollution exposure and episodic memory decline among women >80 years, stratified by exposure time-windows.

	$PM_{2.5}$ Effect Estimates								NO_2 Effect Estimates							
	Recent Exposure[a]				Remote Exposure[a]				Recent Exposure[a]				Remote Exposure[a]			
	N	β[b]	(95% CI)	p	N	β[b]	(95% CI)	p	N	β[b]	(95% CI)	p	N	β[b]	(95% CI)	p
Cognitively-resilient[c]																
Model 2[d] (main)	406	-0.03	(-0.19, 0.13)	0.71	432	0.09	(-0.04, 0.22)	0.18	413	-0.10	(-0.24, 0.03)	0.12	418	-0.02	(-0.17, 0.12)	0.76
Recent exposure IQR[e]	–	–	–	–	432	0.08	(-0.04, 0.19)	0.18	–	–	–	–	418	-0.02	(-0.11, 0.08)	0.76
Without PS[f]	400	-0.03	(-0.18, 0.13)	0.71	433	0.09	(-0.04, 0.22)	0.19	399	-0.11	(-0.24, 0.03)	0.11	398	-0.03	(-0.18, 0.11)	0.67
With practice[g]	418	-0.03	(-0.26, 0.20)	0.80	429	0.09	(-0.04, 0.21)	0.18	419	-0.10	(-0.23, 0.03)	0.12	419	-0.02	(-0.16, 0.12)	0.76
WHIMS-EHCO covariates[h]	399	-0.02	(-0.19, 0.15)	0.81	–	–	–	–	412	-0.10	(-0.23, 0.03)	0.13	–	–	–	–
Steady-decliners[c]																
Model 2[d] (main)	822	-0.03	(-0.20, 0.14)	0.72	796	-0.02	(-0.17, 0.13)	0.79	815	-0.11	(-0.27, 0.05)	0.17	810	-0.05	(-0.22, 0.11)	0.52
Recent exposure IQR[e]	–	–	–	–	796	-0.02	(-0.15, 0.11)	0.79	–	–	–	–	810	-0.04	(-0.14, 0.07)	0.52
Without PS[f]	828	-0.03	(-0.19, 0.14)	0.76	795	-0.02	(-0.17, 0.13)	0.78	829	-0.12	(-0.28, 0.04)	0.15	830	-0.07	(-0.23, 0.09)	0.39
With practice[g]	810	-0.03	(-0.20, 0.13)	0.69	799	-0.02	(-0.17, 0.13)	0.81	809	-0.12	(-0.28, 0.04)	0.15	809	-0.06	(-0.22, 0.10)	0.46
WHIMS-EHCO covariates[h]	829	-0.02	(-0.19, 0.14)	0.77	–	–	–	–	816	-0.11	(-0.27, 0.05)	0.18	–	–	–	–

Numbers of women within each latent class vary because women are assigned to the latent class with the highest probability according to each latent class mixed model.

[a]Recent exposures were 3-year average exposures estimated at the WHIMS-ECHO enrollment. Remote exposures were 3-year average exposures estimated 10 years before the WHIMS-ECHO enrollment.

    recent 3-year $PM_{2.5}$: IQR = 2.88 μg/m^3
    remote 3-year $PM_{2.5}$: IQR = 3.27 μg/m^3
    recent 3-year NO_2: IQR = 6.25 ppb
    remote 3-year NO_2: IQR = 9.47 ppb

[b]β represents the average increase in CVLT score per year for each interquartile range increase of 3-year average exposure. Negative β means greater air pollution exposure was associated with faster decline of episodic memory.

[c]Two latent trajectory subgroups were generated simultaneously from multivariate adjusted models in each scenario listed.

[d]Model 2 was adjusted for age, follow-up time, geographic region, self-reported race/ethnicity (where "other" includes women who reported they were American Indian or Alaskan Native, or Asian or Pacific Islander, or women who selected "other" instead of one of the five specific race/ethnicity categories, and women with missing data for race/ethnicity), SES (education, income, employment status, and neighborhood SES), lifestyle factors (smoking, drinking and physical activities), hormone treatment, cardiovascular risk factors (hypertension, diabetes and hypercholesterolemia), CVD histories, age interaction with follow-up time, and time-varying propensity scores.

[e]Model was adjusted for covariates in Model 2. Remote exposure was scaled by IQR of the corresponding recent exposure.

[f]Model was adjusted for covariates in Model 2, except for time-varying propensity scores.

[g]Model was adjusted for covariates in Model 2 and practice indicator.

Table S7. Summary of latent class-specific associations between air pollution exposure and episodic memory level, stratified by age and exposure time-windows.

	PM$_{2.5}$ Effect Estimates								NO$_2$ Effect Estimates							
	Recent Exposure[a]				Remote Exposure[a]				Recent Exposure[a]				Remote Exposure[a]			
	N	β[b]	(95% CI)	p	N	β[b]	(95% CI)	p	N	β[b]	(95% CI)	p	N	β[b]	(95% CI)	p
≤80 years																
Slow-decliners																
Model 1[c]	626	-0.49	(-1.33, 0.36)	0.26	622	-0.36	(-1.11, 0.39)	0.35	626	-0.10	(-0.93, 0.72)	0.81	625	0.04	(-1.00, 1.08)	0.94
Model 2[d]	605	-0.43	(-1.31, 0.44)	0.33	606	-0.28	(-1.02, 0.47)	0.47	611	0.06	(-0.77, 0.88)	0.89	610	0.26	(-0.57, 1.09)	0.54
Fast-decliners																
Model 1[c]	202	0.34	(-1.28, 1.95)	0.68	206	-0.06	(-1.76, 1.64)	0.94	202	-0.50	(-1.94, 0.93)	0.49	203	-0.86	(-2.37, 0.64)	0.26
Model 2[d]	223	-0.0001	(-0.04, 0.04)	0.99	222	0.10	(-1.16, 1.36)	0.88	217	-0.28	(-1.59, 1.03)	0.67	218	-0.44	(-1.81, 0.94)	0.53
>80 years																
Cognitively-resilient																
Model 1[c]	360	-0.13	(-1.29, 1.04)	0.83	366	0.24	(-0.70, 1.18)	0.62	375	0.72	(-0.25, 1.69)	0.15	375	0.54	(-0.47, 1.54)	0.29
Model 2[d]	410	-0.13	(-1.33, 1.07)	0.83	410	0.21	(-0.71, 1.13)	0.66	422	0.45	(-0.50, 1.39)	0.35	425	0.31	(-0.67, 1.29)	0.54
Steady-decliners																
Model 1[c]	868	0.68	(-0.28, 1.65)	0.17	862	0.41	(-0.42, 1.24)	0.34	853	0.63	(-0.24, 1.50)	0.15	853	0.41	(-0.51, 1.32)	0.38
Model 2[d]	818	0.98	(-0.06, 2.02)	0.07	818	0.48	(-0.40, 1.36)	0.28	806	0.54	(-0.38, 1.47)	0.25	803	0.30	(-0.66, 1.26)	0.54

Numbers of women within each latent class vary because women are assigned to the latent class with the highest probability according to each latent class mixed model.

[a] Recent exposures were 3-year average exposures estimated at the WHIMS-ECHO enrollment. Remote exposures were 3-year average exposures estimated 10 years before the WHIMS-ECHO enrollment.

    recent 3-year PM$_{2.5}$: IQR = 2.88 μg/m^3

    remote 3-year PM$_{2.5}$: IQR = 3.27 μg/m^3

    recent 3-year NO$_2$: IQR = 6.25 ppb

    remote 3-year NO$_2$: IQR = 9.47 ppb

[b] β represents the average increase in CVLT score for each interquartile range (IQR) increase of 3-year average exposure. A negative β means greater air pollution exposure was associated with lower episodic memory.

[c] Model 1 was adjusted for age, follow-up time, age interaction with follow-up time, and time-varying propensity scores.

[d] Model 2 was adjusted for age, follow-up time, geographic region, self-reported race/ethnicity (where "other" includes women who reported they were American Indian or Alaskan Native, or Asian or Pacific Islander, or women who selected "other" instead of one of the five specific race/ethnicity categories, and women with missing data for race/ethnicity), SES (education, income, employment status, and neighborhood SES), lifestyle factors (smoking, drinking and physical activities), hormone treatment, cardiovascular risk factors (hypertension, diabetes and hypercholesterolemia), CVD histories, age interaction with follow-up time, and time-varying propensity scores.

Table S8. Summary of literature review on longitudinal studies investigating the association between ambient air pollution and episodic memory decline.

Population Characteristics	Exposure	Exposure Window	Outcome	Outcome Assessments	Association
Weuve et al., (2012) USA (Nurses' Health Study Cognitive Cohort)	70-81 y/o; 100% F; N=19,409	Spatiotemporal GAM: $PM_{2.5}$; $PM_{2.5-10}$; PM_{10}	1m prior to W1; from 1988 to 1m prior to W1	Verbal memory: Composite score combining immediate and delayed recalls of the EBMT and the TICS	W1: 1995-2001 W2: 1997-2004 W3: 2002-08	$PM_{2.5-10}$ and PM_{10} since 1988 were associated with greater 2-year decline in verbal memory
Tonne et al., (2014) London (Whitehall II)	66±6 y/o; 35% F; N=2,867	Dispersion model: $PM_{2.5}$; PM_{10}	5y average prior to final assessment (2007-09); annual measure at 4y prior to final assessment (2007-09)	Short term Verbal memory: 20-word free-recall test within 2 minutes	W1: 2002-04 W2: 2007-09	No significant association with verbal memory level at Wave 2 $PM_{2.5}$ and PM_{10} at 4 years prior Wave 2 were associated with faster 5-year decline in verbal memory, among those participants residing in greater London at both study waves
Oudin et al., (2017) Sweden (Betula)	60-85 y/o; 45% F; N=1,469	LUR: NO_x	cumulative annual mean (1988-2010)	Episodic memory measure: Composite of 5 tasks - immediate free recall and delayed cued recall of sentences and nouns	5 waves (1988-2010)	No association of baseline NO_x with baseline episodic memory measure No association of time-varying NO_x with 5-year decline in episodic memory
Kulick et al., (2020a) NYC (WHICAP)	≥65 y/o; 68% F; N=4,821	Kriging: PM_{10}; $PM_{2.5}$; NO_2	1y prior to enrollment	Episodic memory: Selective Reminding Test	Every 18-24 months over 20 years (only used data from first 6 waves)	PM_{10}; $PM_{2.5}$; NO_2 associated with faster episodic memory decline, and this association was greater among those ≥75 years old (interaction p<0.001)
Kulick et al., (2020b) NYC (WHICAP; NOMAS)	WHICAP: ≥65 y/o; 67% F; N=5,330 NOMAS: ≥50 y/o; 61% F; N=1,093	WHICAP and NOMAS: Kriging: PM_{10}; $PM_{2.5}$; NO_2 Distance from residence to nearest major roadway	1y prior to enrollment	Episodic memory WHICAP: Selective Reminding Test NOMAS: modified CVLT	WHICAP: every 18-24 months over 20 years (only used data from first 6 waves) NOMAS: baseline (2003-2008) and one follow-up after 5 years	WHICAP: PM_{10}; $PM_{2.5}$; NO_2 associated with lower episodic memory at baseline $PM_{2.5}$ and NO_2 associated with faster decline over time No association of residential distance from roadway with episodic memory level at

						baseline or episodic memory decline over time
						NOMAS: No association of any air pollutants or residential distance from roadway with episodic memory level at baseline or episodic memory decline over time
Petkus et al., (2020) USA (WHISCA)	67-83 y/o; 100% F; N=2,202	Spatiotemporal GAM: PM$_{2.5}$	3y prior to each assessment	CVLT: Immediate (trial 1-3) and short- or long-delayed free recall (List A)	Annually (1999-2010)	PM$_{2.5}$ associated with accelerated declines in immediate recall, and short- & long-delayed free recall
Younan et al., (2020) USA (WHIMS-MRI&WHISCA)	73-87 y/o; 100% F; N=998	Spatiotemporal GAM: PM$_{2.5}$	3y prior to MRI-1 measure (2005-06)	CVLT: Immediate and delayed free recall (List A); new learning (List B); Composite score of the above List A measures	Annually (1999-2010)	PM$_{2.5}$ associated with faster decline in immediate recall and new learning after MRI-1, but not associated with lower level at MRI-1 No association of PM$_{2.5}$ with episodic memory composite score or delayed recall for either level at MRI-1 or decline after MRI-1

Abbreviations: CVLT, California Verbal Learning Test; EBMT, East Boston Memory Test; GAM, Generalized Additive Models; LUR, Land Use Regression; NOMAS, Northern Manhattan Study; TICS, Telephone Interview for Cognitive Status; WHISCA, Women's Health Initiative Study of Cognitive Aging; WHIMS-MRI, Women's Health Initiative Memory Study-Magnetic Resonance Imaging; WHICAP, Washington Heights Inwood Community Aging Project

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