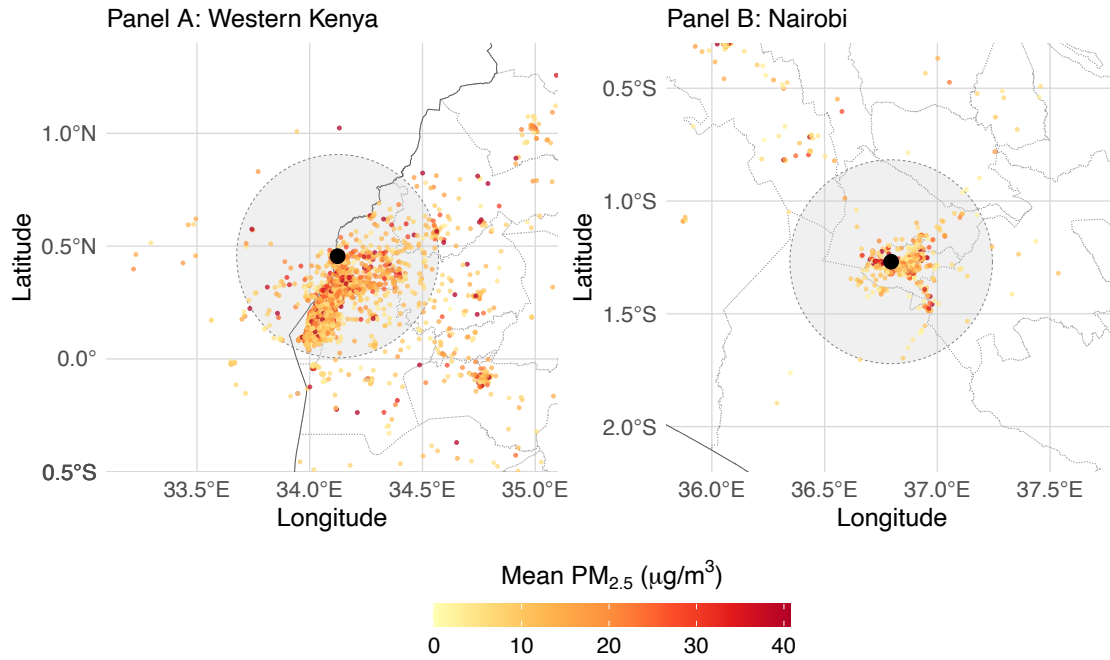


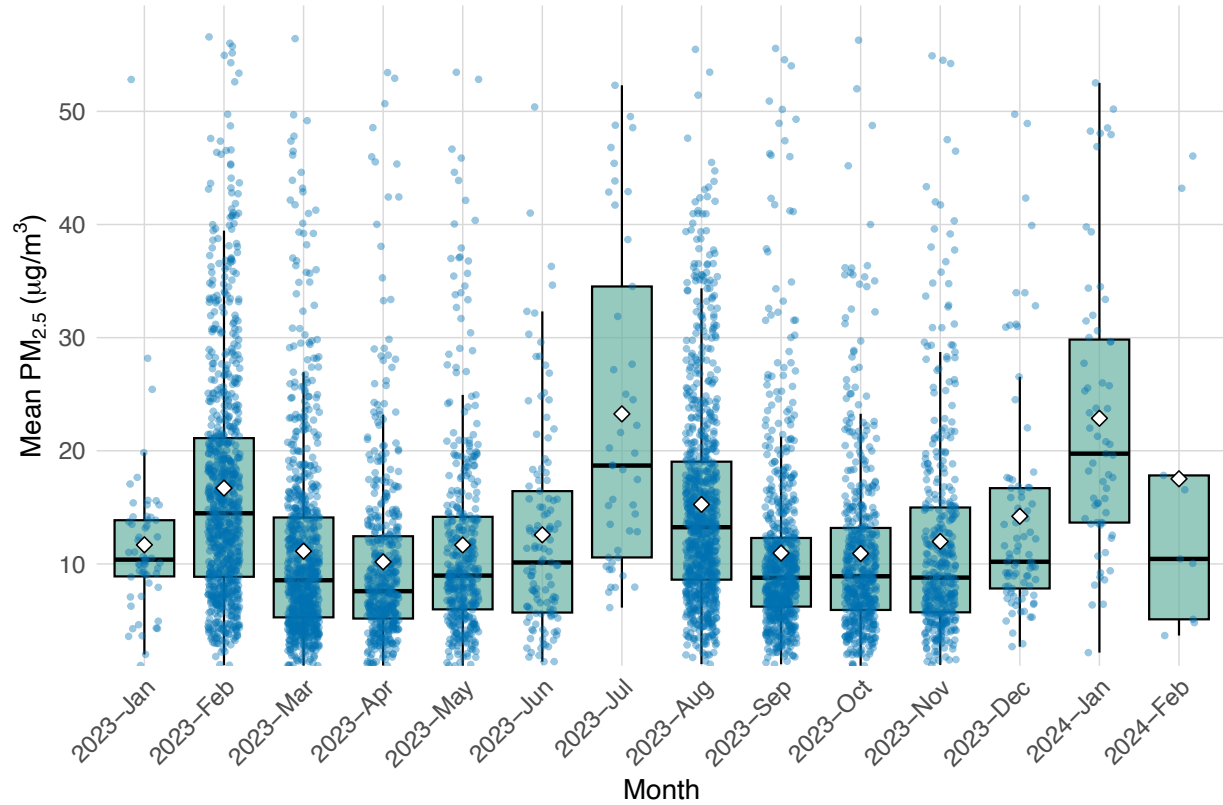
Supplemental Material

Figure S1: Spatial Distribution of Mean PM_{2.5} Levels in Western Kenya and Nairobi



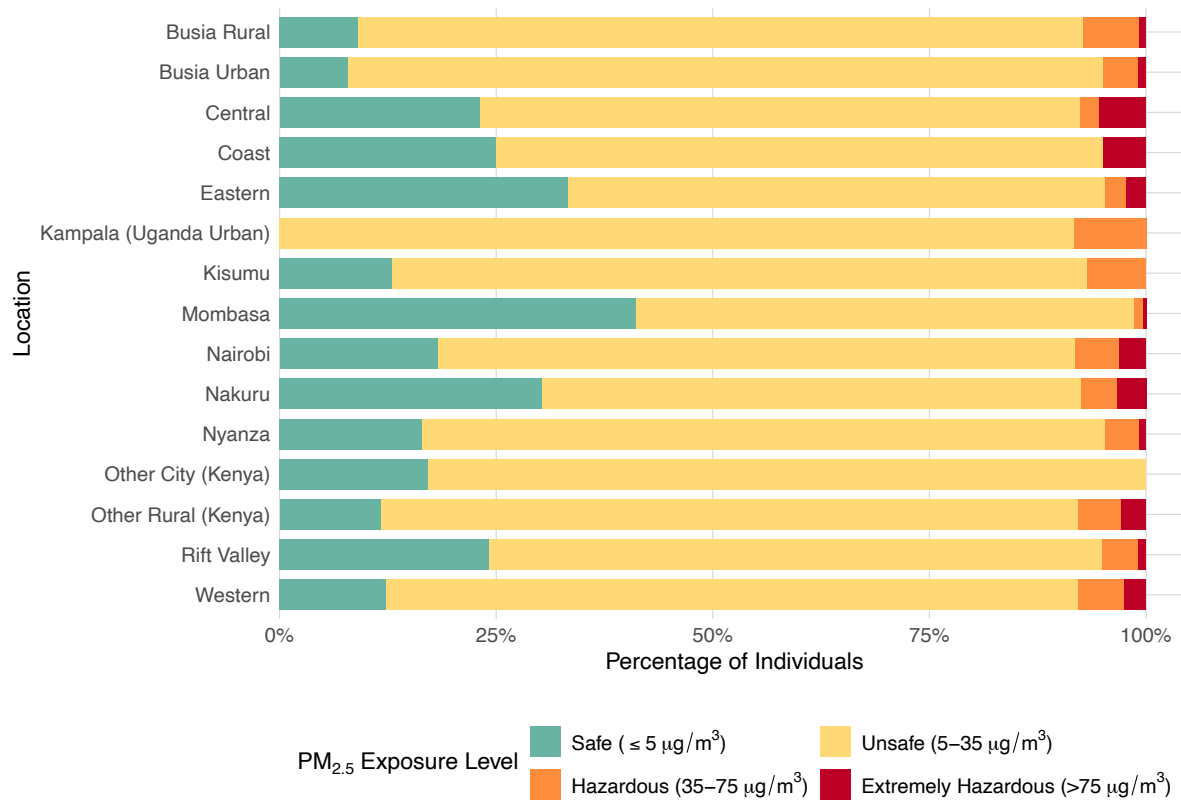
Notes: This figure focuses on PM_{2.5} levels in two regions of Kenya: Western Kenya (Panel A) and Nairobi (Panel B). PM_{2.5} values are individual-level means recorded by Atmotube devices during the cognitive assessment interview window. The large black dots indicate the locations of the PurpleAir ground monitors used for comparison analyses. The grey shaded regions represent a 50 km radius around each monitor. Colors indicate PM_{2.5} concentrations (in µg/m³), with darker shades corresponding to higher exposure levels.

Figure S2: Monthly Distribution of PM_{2.5} Concentrations (Trimmed Top 2.5%)



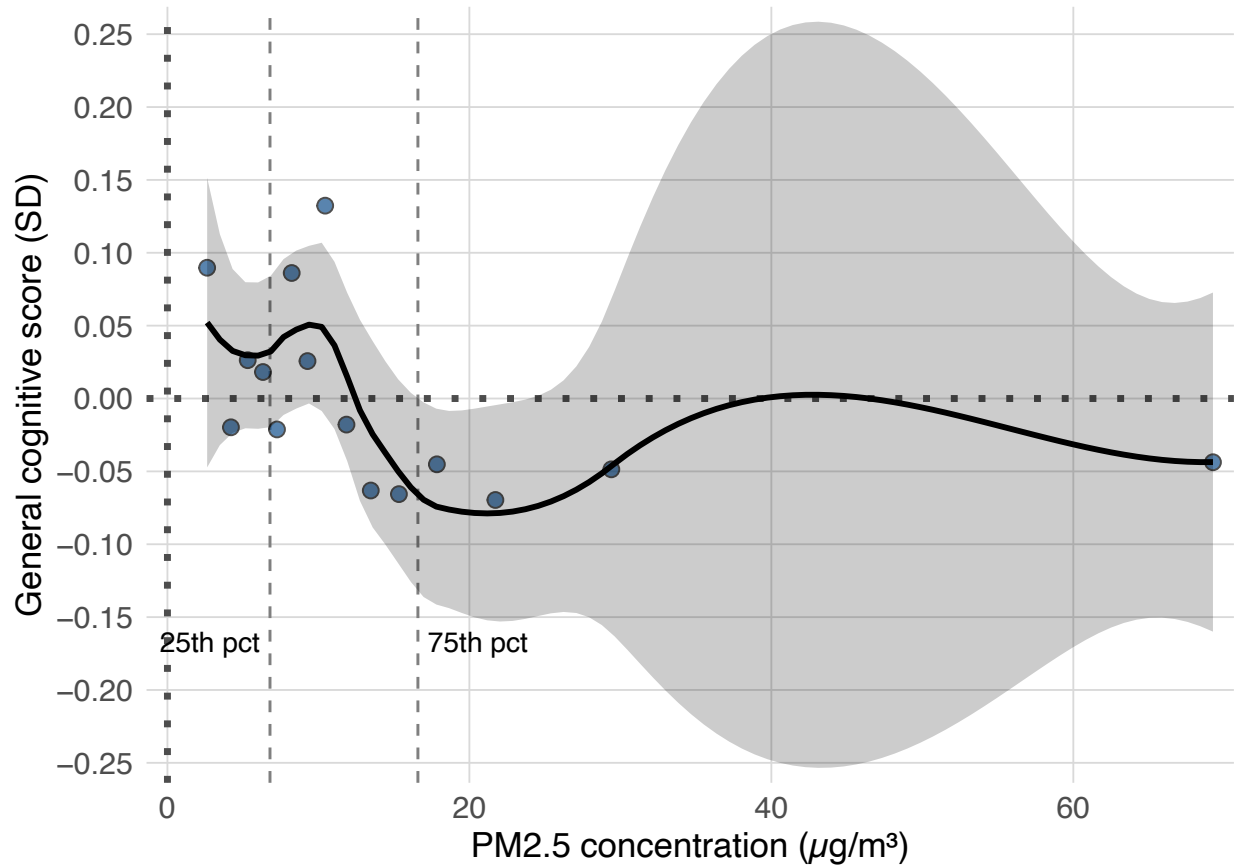
Notes: This figure presents the monthly distribution of individual-level PM_{2.5} exposures recorded by At-motube devices during cognitive assessment interview windows, with the top 2.5% of observations trimmed to remove extreme values. Each box plot represents the spread of PM_{2.5} levels within a given calendar month. The black horizontal line inside each box indicates the median, while the white diamonds indicate the mean. The green boxes represent the interquartile range (IQR), covering the middle 50% of the data. The whiskers extend up to 1.5×IQR. The overlaid blue dots represent individual PM_{2.5} observations.

Figure S3: Share of Population Exposed to Unsafe Air Pollution, by Region



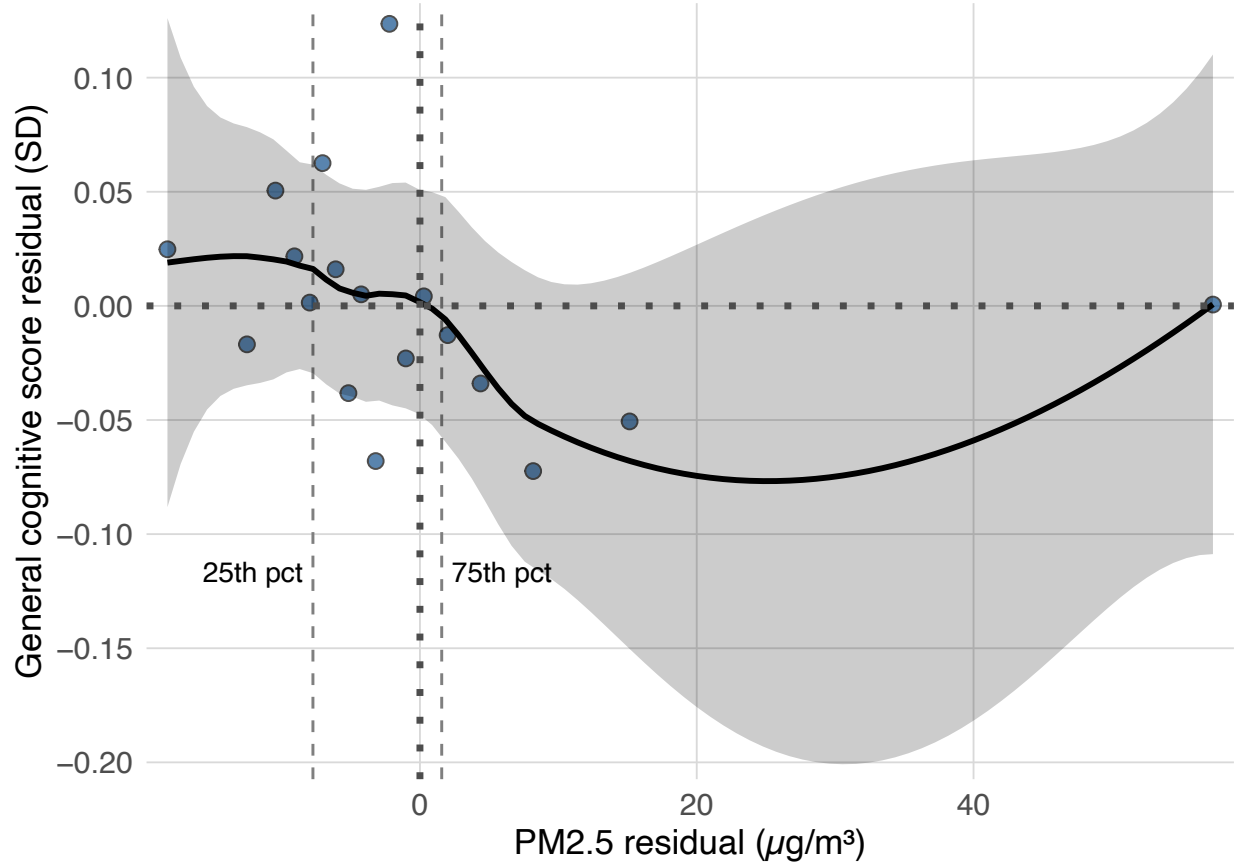
Notes: This figure presents the share of individuals exposed to varying levels of PM_{2.5} pollution across different regions, categorized using the WHO annual guideline and Kenya's national ambient air quality standards. PM_{2.5} values are individual-level means recorded by Atmotube devices during cognitive assessment interview windows. The classification is as follows: Safe ($\leq 5 \mu\text{g}/\text{m}^3$, green): concentrations at or below the WHO annual guideline of $5 \mu\text{g}/\text{m}^3$; Moderate ($5\text{--}35 \mu\text{g}/\text{m}^3$, yellow): concentrations above the WHO guideline but below Kenya's annual ambient air quality standard of $35 \mu\text{g}/\text{m}^3$; Hazardous ($35\text{--}75 \mu\text{g}/\text{m}^3$, orange): concentrations exceeding Kenya's annual limit of $35 \mu\text{g}/\text{m}^3$, indicating elevated long-term health risks; Extremely Hazardous ($>75 \mu\text{g}/\text{m}^3$, red): concentrations exceeding Kenya's 24-hour ambient limit of $75 \mu\text{g}/\text{m}^3$, indicating severe short-term exposure risks. Each bar represents the percentage of individuals within a given region falling into each exposure category.

Figure S4: Cognition vs. PM_{2.5} Exposure (Untrimmed)



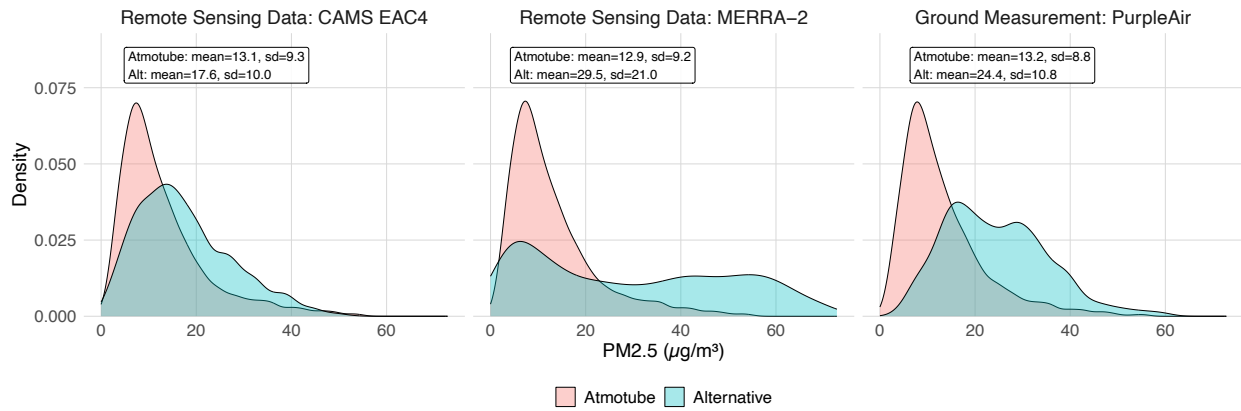
Notes: This figure presents a binned scatterplot of raw general cognitive performance (y-axis, in SD units) against raw PM_{2.5} concentrations (x-axis, in $\mu\text{g}/\text{m}^3$) using the full, untrimmed sample. General cognitive performance is a standardized index (mean zero, unit standard deviation) constructed via confirmatory factor analysis over orientation, memory, executive function, language, and visuospatial subdomains (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading during the cognitive assessment interview window. Observations are grouped into quantile-spaced bins, with the number of bins (19) selected using a data-driven procedure that minimizes the integrated mean squared error of the binscatter estimator, following [Cattaneo et al. \(2024\)](#). Each point plots the within-bin mean PM_{2.5} concentration and within-bin mean general cognitive score. Dashed vertical lines mark the 25th and 75th percentiles of the binned PM_{2.5} distribution, and a LOESS curve (with a 95% confidence band) captures the flexible association between pollution and cognition.

Figure S5: Residualized Cognition vs. PM_{2.5} Exposure (Untrimmed)



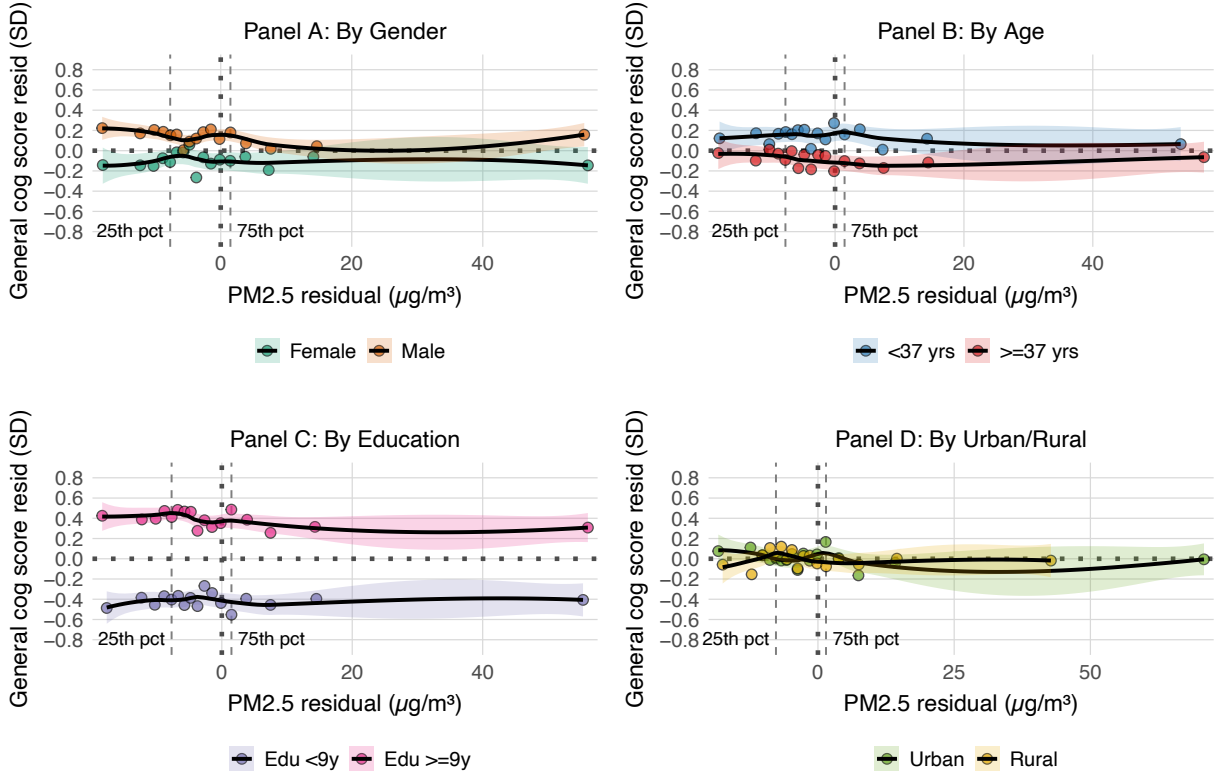
Notes: This figure presents a binned scatterplot of residualized general cognitive performance (y-axis) against residualized PM_{2.5} concentrations (x-axis) using the full, untrimmed sample. General cognitive performance is a standardized index (mean zero, unit standard deviation) constructed via confirmatory factor analysis over orientation, memory, executive function, language, and visuospatial subdomains (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading during the cognitive assessment interview window. Both PM_{2.5} and cognitive scores are residualized by regressing each on hour-of-day, day-of-week, month, and geographic fixed effects; the x-axis therefore shows each bin's average deviation from its predicted mean. The residualized data are grouped into quantile-spaced bins, with the number of bins (16) selected using a data-driven procedure that minimizes the integrated mean squared error of the binscatter estimator, following [Cattaneo et al. \(2024\)](#). Each point plots the within-bin mean PM_{2.5} residual ($\mu\text{g}/\text{m}^3$) and within-bin mean general cognitive residual (SD units). Dashed vertical lines mark the 25th and 75th percentiles of the PM_{2.5} residual distribution, and a LOESS curve (with a 95% confidence band) captures the flexible association.

Figure S6: Distribution of Atmotube and Alternative PM_{2.5} Measures



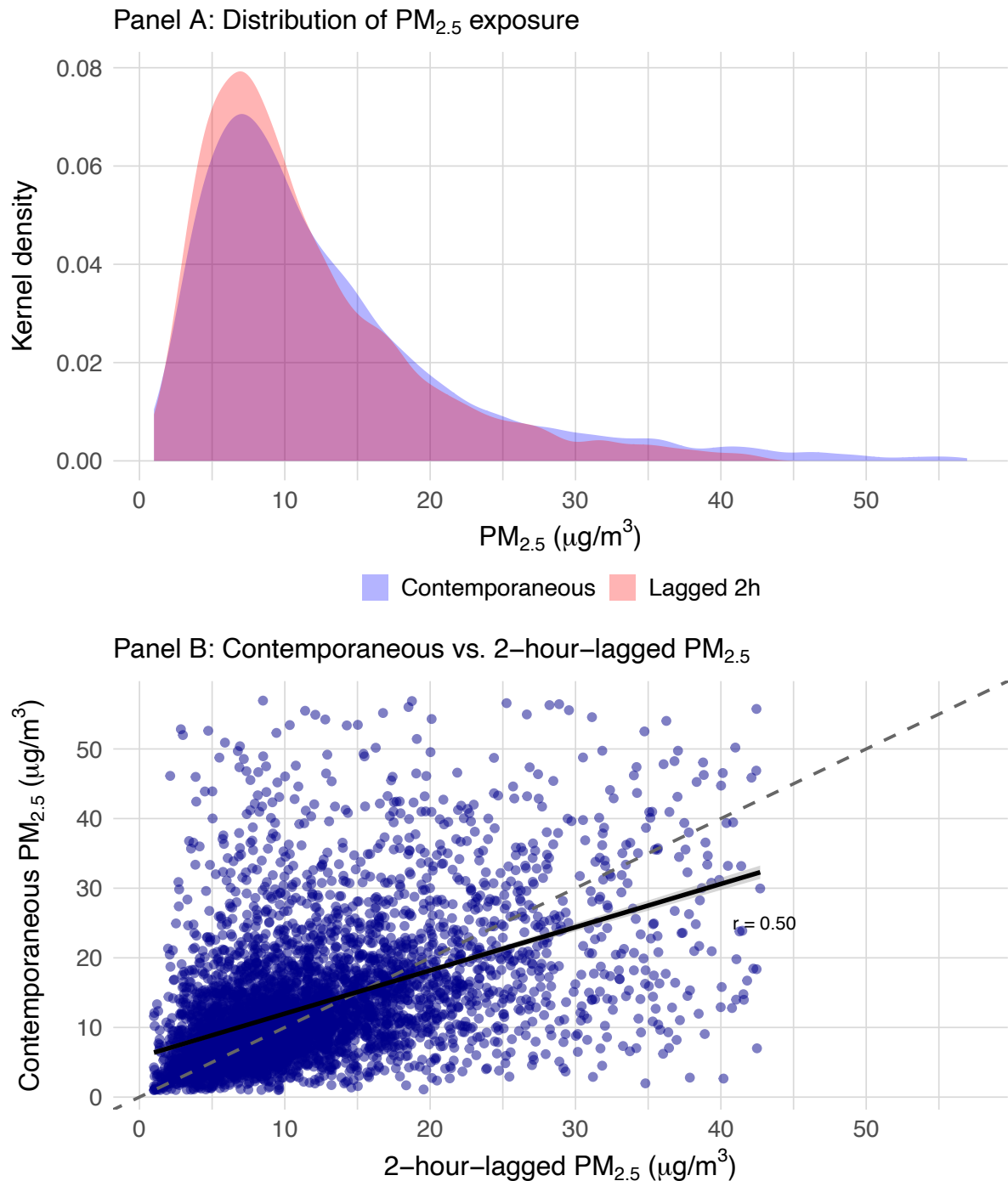
Notes: This figure overlays the empirical distributions of Atmotube PM_{2.5} measurements and alternative PM_{2.5} measures for the matched comparison samples used in three panels: CAMS EAC4, MERRA-2, and PurpleAir. Within each panel, the Atmotube distribution is plotted against the corresponding alternative measure using the subset of observations for which both measures are available. To reduce the influence of extreme values, observations above the 97.5th percentile of either measure within each panel are excluded. The figure reports the mean and standard deviation of each measure within the matched, trimmed sample.

Figure S7: Residualized Cognition vs. PM_{2.5} Exposure, By Subgroup (Untrimmed)



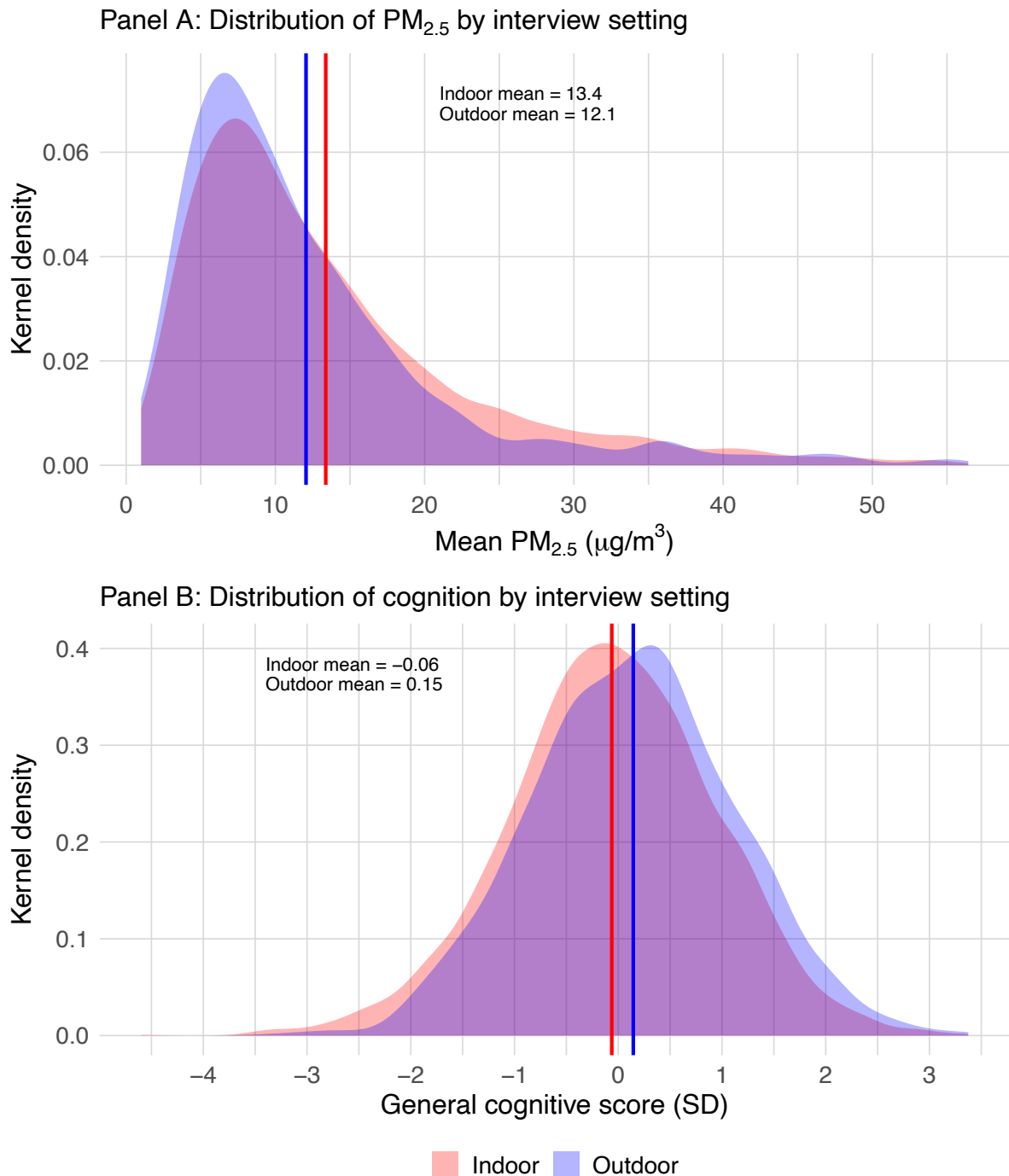
Notes: Panels A–D show binned scatterplots of residualized general cognitive performance (y-axis) against residualized PM_{2.5} (x-axis) within each subgroup, using the full, untrimmed sample. General cognitive performance is a standardized index (mean zero, unit standard deviation) constructed via confirmatory factor analysis over orientation, memory, executive function, language, and visuospatial subdomains (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading during the cognitive assessment interview window. Subgroups are defined as follows: gender (female vs. male), age (below 37 years vs. 37 years or older), education (fewer than 9 years of schooling vs. 9 or more years, i.e., any secondary schooling), and urban vs. rural residence. Both PM_{2.5} and cognitive scores are residualized by regressing each on hour-of-day, day-of-week, month, and geographic fixed effects; the x-axis therefore reflects each bin’s average deviation from its predicted mean. Within each subgroup, observations are grouped into quantile-spaced bins, with the number of bins (19 in each subgroup) selected using a data-driven procedure that minimizes the integrated mean squared error of the binscatter estimator, following [Cattaneo et al. \(2024\)](#). Dashed vertical lines mark the 25th and 75th percentiles of the residual distribution, and a LOESS curve (with 95% confidence band) in each panel captures the flexible association.

Figure S8: Relationship Between Contemporaneous and 2-Hour Lagged PM_{2.5} Exposure



Notes: Panel A shows kernel density estimates of contemporaneous and 2-hour-lagged PM_{2.5} exposures, each computed after dropping the top 2.5% of raw PM_{2.5} values. Contemporaneous PM_{2.5} refers to the mean Atmotube reading during the cognitive assessment interview window. The 2-hour-lagged measure refers to the mean Atmotube reading in the period up to two hours preceding the interview start; because the device was occasionally powered on shortly before fieldwork, the mean available lag window is approximately 101 minutes. Panel B plots 2-hour-lagged PM_{2.5} (x-axis) against contemporaneous PM_{2.5} (y-axis) in the same trimmed sample. The solid line is the fitted ordinary least squares trend (with 95% confidence interval), and the annotated Pearson r shows the correlation between the two measures.

Figure S9: Distributions by Interview Setting



Notes: Panel A displays kernel density estimates of contemporaneous PM_{2.5} exposure for interviews conducted indoors and outdoors. Panel B displays kernel density estimates of the general cognitive index for interviews conducted indoors and outdoors. The general cognitive index is a standardized measure (mean zero, unit standard deviation) constructed via confirmatory factor analysis over orientation, memory, executive function, language, and visuospatial subdomains (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading during the interview window. In both panels, the top 2.5% of PM_{2.5} observations are trimmed to reduce the influence of extreme outliers. Vertical lines indicate mean values by interview setting, with the corresponding values annotated in each panel.

Table S1: Descriptive statistics

	Num. Obs.	Mean	SD	Min	Max
<i>Panel A: Cognitive Measurements</i>					
General Cognitive	5398	0.00	1.00	-4.60	3.37
Orientation	5398	0.00	1.00	-6.85	0.72
Memory	5398	0.00	1.00	-4.19	3.50
Executive Function	5398	0.00	1.00	-4.16	2.90
Language	5398	0.00	1.00	-3.72	2.35
Visuospatial	5398	0.01	0.98	-2.79	1.26
<i>Panel B: Atmotube</i>					
Current PM2.5 ($\mu\text{g}/\text{m}^3$)	5398	15.50	21.16	1.00	440.18
0–10 $\mu\text{g}/\text{m}^3$	2566	6.25	2.22	1.00	9.99
10–20 $\mu\text{g}/\text{m}^3$	1812	14.08	2.78	10.00	19.99
20–30 $\mu\text{g}/\text{m}^3$	511	24.14	2.83	20.03	29.96
30–40 $\mu\text{g}/\text{m}^3$	232	34.37	2.75	30.01	39.99
Above 40 $\mu\text{g}/\text{m}^3$	277	78.66	58.23	40.00	440.18
Lagged Mean PM2.5 (2-hour lag, $\mu\text{g}/\text{m}^3$)	5331	13.24	15.52	1.00	391.72
Humidity (%)	5398	46.29	10.89	5.68	96.29
Temperature ($^{\circ}\text{C}$)	5398	30.04	6.62	18.41	89.24
<i>Panel C: Socioeconomic Factors</i>					
Interviewed Outdoors	5398	0.29	0.45	0.00	1.00
Female	5398	0.56	0.50	0.00	1.00
Age (in 2023)	5376	37.16	2.53	28.00	47.00
Any secondary schooling	5285	0.52	0.50	0.00	1.00

Notes: This table presents descriptive statistics for the analysis sample, restricted to observations with non-missing values for contemporaneous PM_{2.5}, humidity, temperature, interview setting, and the general cognitive index. Panel A reports the mean, standard deviation, minimum, and maximum for the general cognitive index and five subdomain scores (orientation, memory, executive function, language, and visuospatial skills). All cognitive measures are constructed via confirmatory factor analysis (see [Gross et al. \(2025\)](#)) and standardized to have mean zero and unit standard deviation in the full cognitive sample prior to merging with the Atmotube data. Panel B reports the mean, standard deviation, and range for Atmotube-derived environmental measures: contemporaneous PM_{2.5} ($\mu\text{g}/\text{m}^3$, mean during the interview window), 2-hour-lagged PM_{2.5} ($\mu\text{g}/\text{m}^3$, mean in the period up to two hours before the interview), humidity (%), and temperature ($^{\circ}\text{C}$). Panel C reports the mean, standard deviation, and range for key socioeconomic characteristics: an indicator for outdoor interview, gender (female indicator), age in 2023, and an indicator for any secondary schooling (9 or more years).

Table S2: Observations by Region and Month

Town	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Busia Rural	47	558	452	152	134	39	24	485	487	104	121	41	2644
Nairobi	32	274	44	94	117	48	18	336	57	59	93	21	1193
Mombasa	1	1	121	26	11	4	1	0	121	13	7	2	308
Nyanza	1	4	2	96	25	8	0	2	0	87	24	2	251
Western	5	3	78	20	11	2	3	0	0	98	13	2	235
Rift Valley	3	3	51	29	25	4	2	1	8	56	31	2	215
Busia Urban	32	31	16	13	34	5	5	37	12	8	6	8	207
Kisumu	4	0	0	58	11	0	1	0	0	59	9	1	143
Nakuru	0	0	57	11	5	3	1	0	0	50	7	0	134
Other Rural (Kenya)	3	0	0	0	35	3	1	0	0	0	68	1	111
Central	0	3	15	10	20	9	1	10	7	12	15	3	105
Eastern Kenya	1	0	5	9	4	4	0	0	2	22	7	3	57
Other Urban (Kenya)	1	1	0	0	21	3	1	0	0	0	14	3	44
Coast	3	0	5	2	4	0	0	0	19	2	6	1	42
Kampala (Uganda Urban)	2	1	0	0	8	0	0	0	0	0	3	0	14
Total	143	881	846	520	465	132	58	871	713	570	435	96	5703

Notes: This table reports the number of C+ interviews by calendar month and geographic category among interviews with nonmissing geographic and calendar-month information. These counts are calculated before applying the Atmotube-matching requirements and other restrictions used to construct the main regression sample; accordingly, they should not be interpreted as regression-sample counts. The geographic categories correspond to those used in the preferred fixed-effects specification and comprise major cities (Busia Urban, Kisumu, Mombasa, Nairobi, Nakuru, and Kampala), Busia Rural, Kenyan provincial groupings (Western, Nyanza, Coast, Central, Eastern, Rift Valley, and North Eastern), and residual Other Urban and Other Rural categories.

Table S3: Association between contemporaneous PM_{2.5} exposure and orientation

	(1) Orientation	(2) Orientation	(3) Orientation	(4) Orientation
Mean PM _{2.5}	.0007 (.0017)	-.0000 (.0017)	-.0002 (.0017)	
PM _{2.5} 10-20 $\mu\text{g}/\text{m}^3$				.0054 (.0389)
PM _{2.5} 20-30 $\mu\text{g}/\text{m}^3$				.0516 (.0408)
PM _{2.5} 30-40 $\mu\text{g}/\text{m}^3$				-.0168 (.0806)
PM _{2.5} above 40 $\mu\text{g}/\text{m}^3$				.0240 (.0767)
Temperature ($^{\circ}\text{C}$)	-.0013 (.0017)	-.0042*** (.0011)	-.0049*** (.0015)	-.0051*** (.0016)
Interviewed Outdoor	.0493 (.0553)	.1198*** (.0201)	.0775** (.0261)	.0790*** (.0262)
Female			-.1052* (.0557)	-.1044* (.0564)
Age			-.0127*** (.0025)	-.0126*** (.0025)
Any Secondary Schooling			.2749*** (.0217)	.2751*** (.0215)
Geographic and Time FE	NO	YES	YES	YES
Number Observations	5264	5264	5131	5131
Adjusted R-squared	.002	.039	.063	.062

Notes: This table presents the estimated association between contemporaneous PM_{2.5} exposure and an orientation index. The orientation index captures awareness of time, place, and person, is standardized to have mean zero and unit standard deviation, and is constructed via confirmatory factor analysis as part of the broader cognitive battery (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature, mean humidity, and the interview setting (indoor vs. outdoor). Column (1) includes no fixed effects. Columns (2)–(4) include hour-of-day, day-of-week, month, and geographic fixed effects. Column (3) additionally controls for gender, age, and an indicator for any secondary schooling. Columns (1)–(3) model PM_{2.5} as a continuous linear term. Column (4) replaces the linear term with categorical bins (10–20 $\mu\text{g}/\text{m}^3$, 20–30 $\mu\text{g}/\text{m}^3$, 30–40 $\mu\text{g}/\text{m}^3$, and above 40 $\mu\text{g}/\text{m}^3$), with PM_{2.5} ≤ 10 $\mu\text{g}/\text{m}^3$ as the omitted reference category. Standard errors are clustered at the geographic level and reported in parentheses. Statistical significance is denoted as follows: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table S4: Association between contemporaneous PM_{2.5} exposure and memory

	(1) Memory	(2) Memory	(3) Memory	(4) Memory
Mean PM2.5	-.0033*** (.0008)	-.0026* (.0014)	-.0027* (.0015)	
PM2.5 10-20 $\mu\text{g}/\text{m}^3$				-.0520* (.0295)
PM2.5 20-30 $\mu\text{g}/\text{m}^3$				-.0500 (.0395)
PM2.5 30-40 $\mu\text{g}/\text{m}^3$				-.0639 (.0694)
PM2.5 above 40 $\mu\text{g}/\text{m}^3$				-.1249* (.0589)
Temperature ($^{\circ}\text{C}$)	.0020* (.0011)	.0006 (.0012)	.0011 (.0009)	.0010 (.0009)
Interviewed Outdoor	.1253*** (.0363)	.1102*** (.0354)	.0694* (.0343)	.0703* (.0354)
Female			.0108 (.0409)	.0115 (.0414)
Age			-.0314*** (.0034)	-.0315*** (.0034)
Any Secondary Schooling			.6012*** (.0232)	.6013*** (.0232)
Geographic and Time FE	NO	YES	YES	YES
Number Observations	5264	5264	5131	5131
Adjusted R-squared	.004	.026	.130	.130

Notes: This table presents the estimated association between contemporaneous PM_{2.5} exposure and a memory index. The memory index captures immediate and delayed recall performance, is standardized to have mean zero and unit standard deviation, and is constructed via confirmatory factor analysis as part of the broader cognitive battery (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature, mean humidity, and the interview setting (indoor vs. outdoor). Column (1) includes no fixed effects. Columns (2)–(4) include hour-of-day, day-of-week, month, and geographic fixed effects. Column (3) additionally controls for gender, age, and an indicator for any secondary schooling. Columns (1)–(3) model PM_{2.5} as a continuous linear term. Column (4) replaces the linear term with categorical bins (10–20 $\mu\text{g}/\text{m}^3$, 20–30 $\mu\text{g}/\text{m}^3$, 30–40 $\mu\text{g}/\text{m}^3$, and above 40 $\mu\text{g}/\text{m}^3$), with PM_{2.5} $\leq$ 10 $\mu\text{g}/\text{m}^3$ as the omitted reference category. Standard errors are clustered at the geographic level and reported in parentheses. Statistical significance is denoted as follows: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table S5: Association between contemporaneous PM_{2.5} exposure and executive function

	(1) Executive Function	(2) Executive Function	(3) Executive Function	(4) Executive Function
Mean PM2.5	-.0028*** (.0007)	-.0020* (.0011)	-.0026** (.0009)	
PM2.5 10-20 µg/m ³				-.0296 (.0223)
PM2.5 20-30 µg/m ³				-.0401 (.0276)
PM2.5 30-40 µg/m ³				-.0665 (.0452)
PM2.5 above 40 µg/m ³				-.1580** (.0686)
Temperature (°C)	.0009 (.0017)	.0001 (.0021)	-.0012 (.0018)	-.0013 (.0019)
Interviewed Outdoor	.2288*** (.0546)	.1823*** (.0524)	.0769 (.0451)	.0774 (.0456)
Female			-.2861*** (.0378)	-.2860*** (.0382)
Age			-.0332*** (.0050)	-.0332*** (.0050)
Any Secondary Schooling			.6900*** (.0156)	.6903*** (.0155)
Geographic and Time FE	NO	YES	YES	YES
Number Observations	5264	5264	5131	5131
Adjusted R-squared	.012	.034	.196	.196

Notes: This table presents the estimated association between contemporaneous PM_{2.5} exposure and an executive function index. The executive function index captures set-shifting, inhibition, and working memory, is standardized to have mean zero and unit standard deviation, and is constructed via confirmatory factor analysis as part of the broader cognitive battery (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading (µg/m³) during the cognitive assessment interview window. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature, mean humidity, and the interview setting (indoor vs. outdoor). Column (1) includes no fixed effects. Columns (2)–(4) include hour-of-day, day-of-week, month, and geographic fixed effects. Column (3) additionally controls for gender, age, and an indicator for any secondary schooling. Columns (1)–(3) model PM_{2.5} as a continuous linear term. Column (4) replaces the linear term with categorical bins (10–20 µg/m³, 20–30 µg/m³, 30–40 µg/m³, and above 40 µg/m³), with PM_{2.5} ≤ 10 µg/m³ as the omitted reference category. Standard errors are clustered at the geographic level and reported in parentheses. Statistical significance is denoted as follows: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table S6: Association between contemporaneous PM_{2.5} exposure and language

	(1)	(2)	(3)	(4)
	Language	Language	Language	Language
Mean PM _{2.5}	-.0015 (.0010)	-.0003 (.0011)	-.0003 (.0009)	
PM _{2.5} 10-20 $\mu\text{g}/\text{m}^3$				-.0246 (.0286)
PM _{2.5} 20-30 $\mu\text{g}/\text{m}^3$				-.0004 (.0343)
PM _{2.5} 30-40 $\mu\text{g}/\text{m}^3$				-.0356 (.0332)
PM _{2.5} above 40 $\mu\text{g}/\text{m}^3$				-.0015 (.0586)
Temperature ($^{\circ}\text{C}$)	.0017 (.0015)	-.0004 (.0020)	-.0013 (.0025)	-.0012 (.0025)
Interviewed Outdoor	.1545* (.0728)	.1174* (.0648)	.0641 (.0622)	.0646 (.0620)
Female			-.0630 (.0397)	-.0622 (.0394)
Age			-.0106** (.0036)	-.0106** (.0036)
Any Secondary Schooling			.6190*** (.0262)	.6190*** (.0264)
Geographic and Time FE	NO	YES	YES	YES
Number Observations	5264	5264	5131	5131
Adjusted R-squared	.006	.029	.128	.128

Notes: This table presents the estimated association between contemporaneous PM_{2.5} exposure and a language index. The language index captures verbal fluency and naming ability, is standardized to have mean zero and unit standard deviation, and is constructed via confirmatory factor analysis as part of the broader cognitive battery (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature, mean humidity, and the interview setting (indoor vs. outdoor). Column (1) includes no fixed effects. Columns (2)–(4) include hour-of-day, day-of-week, month, and geographic fixed effects. Column (3) additionally controls for gender, age, and an indicator for any secondary schooling. Columns (1)–(3) model PM_{2.5} as a continuous linear term. Column (4) replaces the linear term with categorical bins (10–20 $\mu\text{g}/\text{m}^3$, 20–30 $\mu\text{g}/\text{m}^3$, 30–40 $\mu\text{g}/\text{m}^3$, and above 40 $\mu\text{g}/\text{m}^3$), with PM_{2.5} $\leq$ 10 $\mu\text{g}/\text{m}^3$ as the omitted reference category. Standard errors are clustered at the geographic level and reported in parentheses. Statistical significance is denoted as follows: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table S7: Association between contemporaneous PM_{2.5} exposure and visuospatial skills

	(1) Visuospatial	(2) Visuospatial	(3) Visuospatial	(4) Visuospatial
Mean PM _{2.5}	-.0023** (.0008)	-.0022** (.0008)	-.0025** (.0009)	
PM _{2.5} 10-20 µg/m ³				-.0388* (.0204)
PM _{2.5} 20-30 µg/m ³				-.0519 (.0383)
PM _{2.5} 30-40 µg/m ³				-.0922*** (.0242)
PM _{2.5} above 40 µg/m ³				-.1211** (.0505)
Temperature (°C)	.0013 (.0013)	.0011 (.0010)	.0001 (.0008)	.0002 (.0008)
Interviewed Outdoor	.1639*** (.0328)	.1392*** (.0388)	.0369 (.0307)	.0369 (.0311)
Female			-.3211*** (.0279)	-.3210*** (.0282)
Age			-.0073 (.0043)	-.0074 (.0043)
Any Secondary Schooling			.5308*** (.0155)	.5310*** (.0155)
Geographic and Time FE	NO	YES	YES	YES
Number Observations	5264	5264	5131	5131
Adjusted R-squared	.006	.012	.118	.118

Notes: This table presents the estimated association between contemporaneous PM_{2.5} exposure and a visuospatial index. The visuospatial index captures spatial reasoning and constructional ability, is standardized to have mean zero and unit standard deviation, and is constructed via confirmatory factor analysis as part of the broader cognitive battery (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading (µg/m³) during the cognitive assessment interview window. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature, mean humidity, and the interview setting (indoor vs. outdoor). Column (1) includes no fixed effects. Columns (2)–(4) include hour-of-day, day-of-week, month, and geographic fixed effects. Column (3) additionally controls for gender, age, and an indicator for any secondary schooling. Columns (1)–(3) model PM_{2.5} as a continuous linear term. Column (4) replaces the linear term with categorical bins (10–20 µg/m³, 20–30 µg/m³, 30–40 µg/m³, and above 40 µg/m³), with PM_{2.5} ≤ 10 µg/m³ as the omitted reference category. Standard errors are clustered at the geographic level and reported in parentheses. Statistical significance is denoted as follows: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table S8: Linearity Comparison Across PurpleAir Distance Thresholds

	50 km		100 km		200 km	
	(1)	(2)	(3)	(4)	(5)	(6)
	Atmotube	PurpleAir	Atmotube	PurpleAir	Atmotube	PurpleAir
Mean PM _{2.5}	-.0030*	-.0024***	-.0030**	-.0019*	-.0028**	-.0018*
	(.0014)	(.0007)	(.0012)	(.0009)	(.0012)	(.0009)
Temperature (°C)	.0006	.0000	.0007	.0001	.0005	-.0001
	(.0018)	(.0014)	(.0016)	(.0013)	(.0018)	(.0015)
Interviewed Outdoor	.1599*	.1604*	.1581*	.1583*	.1510*	.1514**
	(.0815)	(.0781)	(.0749)	(.0725)	(.0716)	(.0694)
Female	-.1293**	-.1298**	-.1407***	-.1410***	-.1389***	-.1392***
	(.0420)	(.0424)	(.0409)	(.0409)	(.0383)	(.0384)
Age	-.0292***	-.0291***	-.0314***	-.0313***	-.0320***	-.0319***
	(.0028)	(.0028)	(.0042)	(.0042)	(.0044)	(.0044)
Any Secondary Schooling	.7352***	.7346***	.7343***	.7340***	.7442***	.7443***
	(.0184)	(.0193)	(.0166)	(.0168)	(.0159)	(.0159)
Geographic and Time FE	YES	YES	YES	YES	YES	YES
Number Observations	3359	3359	3682	3682	3884	3884
Adjusted R-squared	.181	.181	.191	.190	.200	.200

Notes: This table compares the estimated association between PM_{2.5} exposure and general cognitive performance across PurpleAir aggregation thresholds of 25 km, 50 km, 100 km, and 200 km. For each threshold, the odd-numbered column reports the coefficient on mean Atmotube PM_{2.5} using the corresponding PurpleAir-available subsample, and the even-numbered column reports the coefficient on the PurpleAir-based PM_{2.5} measure constructed using monitors within the indicated distance threshold. General cognitive performance is standardized to have mean zero and unit standard deviation. PM_{2.5} is measured as the mean concentration ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. The top 2.5% of Atmotube PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature, mean humidity, interview setting, gender, age, and secondary schooling. All regressions include hour-of-day, day-of-week, month, and geographic fixed effects. Standard errors, clustered at the geographic level, are reported in parentheses. Statistical significance is denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table S9: Interaction Effects on Orientation

	(1) Orientation	(2) Orientation	(3) Orientation	(4) Orientation	(5) Orientation	(6) Orientation
Mean PM2.5	-.0033* (.0017)	.0016 (.0017)	-.0005 (.0020)	-.0017 (.0029)	-.0001 (.0019)	-.0051 (.0036)
Female	-.1801** (.0717)	-.0990 (.0568)	-.1053* (.0557)	-.1048* (.0557)	-.1053* (.0559)	-.1757** (.0711)
Female x PM2.5	.0058** (.0023)					.0060** (.0020)
Age $\geq$ 37		.0083 (.0201)				-.0045 (.0221)
Age $\geq$ 37 x PM2.5		-.0030** (.0013)				-.0019 (.0013)
Any Secondary Schooling	.2752*** (.0215)	.2861*** (.0219)	.2677*** (.0313)	.2750*** (.0217)	.2749*** (.0215)	.2667*** (.0354)
Any Secondary Schooling $\times$ PM2.5			.0005 (.0014)			.0015 (.0017)
Rural				-.0903* (.0443)		-.0961* (.0470)
Rural x PM2.5				.0024 (.0026)		.0026 (.0031)
Interviewed Outdoor	.0790*** (.0262)	.0785*** (.0260)	.0775** (.0261)	.0763** (.0262)	.0833 (.0518)	.0605 (.0533)
Interviewed Outdoor x PM2.5					-.0005 (.0029)	.0014 (.0028)
Temperature ($^{\circ}$ C)	-.0046*** (.0014)	-.0049*** (.0013)	-.0049*** (.0014)	-.0045** (.0016)	-.0049*** (.0014)	-.0044*** (.0014)
Geographic and Time FE	YES	YES	YES	YES	YES	YES
Number Observations	5131	5131	5131	5131	5131	5131
Adjusted R-squared	.063	.062	.062	.062	.062	.062

Notes: This table presents the estimated association between PM_{2.5} exposure and an orientation index, with interactions by gender, age, education, rural residence, and interview setting. The orientation index captures awareness of time, place, and person, is standardized to have mean zero and unit standard deviation, and is constructed via confirmatory factor analysis as part of the broader cognitive battery (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. Interaction variables are defined as follows: Female is a binary indicator equal to one for female respondents; Age $\geq$ 37 is a binary indicator equal to one for respondents aged 37 or older in 2023, where 37 is the median age in the sample; Any Secondary Schooling equals one if the respondent completed 9 or more years of schooling; Rural equals one for respondents in rural survey locations; and Interviewed Outdoor equals one if the assessment was conducted outdoors. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature and mean humidity. All regressions include hour-of-day, day-of-week, month, and geographic fixed effects. Columns (1), (3), (4), and (5) control for continuous age in years. Column (6) includes all interaction terms simultaneously. Standard errors, clustered at the geographic level, are reported in parentheses. Statistical significance is denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table S10: Interaction Effects on Memory

	(1) Memory	(2) Memory	(3) Memory	(4) Memory	(5) Memory	(6) Memory
Mean PM2.5	-.0032 (.0021)	-.0017 (.0013)	-.0007 (.0014)	-.0051** (.0020)	-.0025 (.0017)	-.0014 (.0027)
Female	.0001 (.0595)	.0259 (.0411)	.0112 (.0410)	.0111 (.0410)	.0106 (.0405)	.0279 (.0552)
Female x PM2.5	.0008 (.0018)					-.0001 (.0016)
Age ≥ 37		-.0661 (.0422)				-.0540 (.0443)
Age ≥ 37 x PM2.5		-.0018 (.0031)				-.0027 (.0033)
Any Secondary Schooling	.6012*** (.0231)	.6257*** (.0213)	.6503*** (.0318)	.6012*** (.0232)	.6013*** (.0235)	.6764*** (.0295)
Any Secondary Schooling $\times$ PM2.5			-.0038** (.0017)			-.0039* (.0019)
Rural				-.0895 (.0929)		-.0922 (.0895)
Rural x PM2.5				.0039 (.0028)		.0036 (.0023)
Interviewed Outdoor	.0697* (.0341)	.0708* (.0332)	.0698* (.0349)	.0688* (.0339)	.0801 (.0567)	.0647 (.0550)
Interviewed Outdoor x PM2.5					-.0009 (.0024)	.0005 (.0022)
Temperature ($^{\circ}\text{C}$)	.0011 (.0009)	.0011 (.0010)	.0013 (.0009)	.0017* (.0008)	.0011 (.0009)	.0017* (.0009)
Geographic and Time FE	YES	YES	YES	YES	YES	YES
Number Observations	5131	5131	5131	5131	5131	5131
Adjusted R-squared	.130	.126	.131	.130	.130	.126

Notes: This table presents the estimated association between PM_{2.5} exposure and a memory index, with interactions by gender, age, education, rural residence, and interview setting. The memory index captures immediate and delayed recall performance, is standardized to have mean zero and unit standard deviation, and is constructed via confirmatory factor analysis as part of the broader cognitive battery (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. Interaction variables are defined as follows: Female is a binary indicator equal to one for female respondents; Age ≥ 37 is a binary indicator equal to one for respondents aged 37 or older in 2023, where 37 is the median age in the sample; Any Secondary Schooling equals one if the respondent completed 9 or more years of schooling; Rural equals one for respondents in rural survey locations; and Interviewed Outdoor equals one if the assessment was conducted outdoors. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature and mean humidity. All regressions include hour-of-day, day-of-week, month, and geographic fixed effects. Columns (1), (3), (4), and (5) control for continuous age in years. Column (6) includes all interaction terms simultaneously. Standard errors, clustered at the geographic level, are reported in parentheses. Statistical significance is denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table S11: Interaction Effects on Executive Function

	(1) Executive Function	(2) Executive Function	(3) Executive Function	(4) Executive Function	(5) Executive Function	(6) Executive Function
Mean PM2.5	-.0026** (.0011)	-.0024** (.0011)	.0025 (.0016)	-.0032** (.0012)	-.0027*** (.0009)	.0053*** (.0017)
Female	-.2857*** (.0458)	-.2710*** (.0387)	-.2850*** (.0384)	-.2851*** (.0378)	-.2861*** (.0381)	-.2460*** (.0447)
Female x PM2.5	-.0000 (.0014)					-.0018 (.0011)
Age ≥ 37		-.0989*** (.0268)				-.0709** (.0251)
Age ≥ 37 x PM2.5		-.0003 (.0014)				-.0024* (.0013)
Any Secondary Schooling	.6900*** (.0156)	.7139*** (.0142)	.8171*** (.0464)	.6907*** (.0154)	.6900*** (.0154)	.8529*** (.0471)
Any Secondary Schooling $\times$ PM2.5			-.0097*** (.0021)			-.0106*** (.0023)
Rural				-.1630* (.0819)		-.1548* (.0805)
Rural x PM2.5				.0010 (.0017)		-.0001 (.0017)
Interviewed Outdoor	.0769 (.0450)	.0780 (.0446)	.0779 (.0469)	.0736 (.0453)	.0749** (.0281)	.0632** (.0223)
Interviewed Outdoor x PM2.5					.0002 (.0029)	.0010 (.0034)
Temperature ($^{\circ}$ C)	-.0012 (.0018)	-.0012 (.0021)	-.0008 (.0017)	-.0011 (.0018)	-.0012 (.0018)	-.0010 (.0020)
Geographic and Time FE	YES	YES	YES	YES	YES	YES
Number Observations	5131	5131	5131	5131	5131	5131
Adjusted R-squared	.196	.192	.198	.197	.196	.194

Notes: This table presents the estimated association between PM_{2.5} exposure and an executive function index, with interactions by gender, age, education, rural residence, and interview setting. The executive function index captures set-shifting, inhibition, and working memory, is standardized to have mean zero and unit standard deviation, and is constructed via confirmatory factor analysis as part of the broader cognitive battery (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. Interaction variables are defined as follows: Female is a binary indicator equal to one for female respondents; Age ≥ 37 is a binary indicator equal to one for respondents aged 37 or older in 2023, where 37 is the median age in the sample; Any Secondary Schooling equals one if the respondent completed 9 or more years of schooling; Rural equals one for respondents in rural survey locations; and Interviewed Outdoor equals one if the assessment was conducted outdoors. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature and mean humidity. All regressions include hour-of-day, day-of-week, month, and geographic fixed effects. Columns (1), (3), (4), and (5) control for continuous age in years. Column (6) includes all interaction terms simultaneously. Standard errors, clustered at the geographic level, are reported in parentheses. Statistical significance is denoted as follows: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table S12: Interaction Effects on Language

	(1) Language	(2) Language	(3) Language	(4) Language	(5) Language	(6) Language
Mean PM2.5	-.0026 (.0015)	.0018 (.0012)	.0004 (.0014)	-.0008 (.0012)	-.0017 (.0015)	-.0031 (.0028)
Female	-.1176** (.0445)	-.0553 (.0400)	-.0629 (.0399)	-.0632 (.0398)	-.0618 (.0393)	-.1144** (.0520)
Female x PM2.5	.0042* (.0022)					.0047* (.0025)
Age $\geq$ 37		.0405 (.0282)				.0377 (.0297)
Age $\geq$ 37 x PM2.5		-.0035** (.0014)				-.0033* (.0016)
Any Secondary Schooling	.6192*** (.0261)	.6331*** (.0263)	.6380*** (.0431)	.6188*** (.0263)	.6184*** (.0257)	.6535*** (.0448)
Any Secondary Schooling $\times$ PM2.5			-.0015 (.0014)			-.0016 (.0015)
Rural				.0195 (.0826)		.0050 (.0812)
Rural x PM2.5				.0007 (.0012)		.0018 (.0012)
Interviewed Outdoor	.0652 (.0623)	.0652 (.0625)	.0642 (.0625)	.0647 (.0623)	.0043 (.0818)	-.0157 (.0802)
Interviewed Outdoor x PM2.5					.0048** (.0022)	.0067*** (.0020)
Temperature ($^{\circ}$ C)	-.0011 (.0025)	-.0013 (.0026)	-.0012 (.0025)	-.0012 (.0025)	-.0014 (.0024)	-.0009 (.0025)
Geographic and Time FE	YES	YES	YES	YES	YES	YES
Number Observations	5131	5131	5131	5131	5131	5131
Adjusted R-squared	.128	.128	.128	.128	.128	.128

Notes: This table presents the estimated association between PM_{2.5} exposure and a language index, with interactions by gender, age, education, rural residence, and interview setting. The language index captures verbal fluency and naming ability, is standardized to have mean zero and unit standard deviation, and is constructed via confirmatory factor analysis as part of the broader cognitive battery (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. Interaction variables are defined as follows: Female is a binary indicator equal to one for female respondents; Age $\geq$ 37 is a binary indicator equal to one for respondents aged 37 or older in 2023, where 37 is the median age in the sample; Any Secondary Schooling equals one if the respondent completed 9 or more years of schooling; Rural equals one for respondents in rural survey locations; and Interviewed Outdoor equals one if the assessment was conducted outdoors. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature and mean humidity. All regressions include hour-of-day, day-of-week, month, and geographic fixed effects. Columns (1), (3), (4), and (5) control for continuous age in years. Column (6) includes all interaction terms simultaneously. Standard errors, clustered at the geographic level, are reported in parentheses. Statistical significance is denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table S13: Interaction Effects on Visuospatial Skills

	(1) Visuospatial	(2) Visuospatial	(3) Visuospatial	(4) Visuospatial	(5) Visuospatial	(6) Visuospatial
Mean PM2.5	-.0038*** (.0011)	-.0011 (.0017)	-.0014 (.0023)	-.0053** (.0019)	-.0015 (.0009)	-.0023 (.0036)
Female	-.3517*** (.0413)	-.3140*** (.0295)	-.3208*** (.0281)	-.3219*** (.0282)	-.3220*** (.0277)	-.3293*** (.0428)
Female x PM2.5	.0024 (.0015)					.0011 (.0014)
Age ≥ 37		.0402 (.0386)				.0441 (.0400)
Age ≥ 37 x PM2.5		-.0024 (.0024)				-.0027 (.0025)
Any Secondary Schooling	.5310*** (.0155)	.5434*** (.0141)	.5595*** (.0460)	.5300*** (.0155)	.5313*** (.0154)	.5670*** (.0515)
Any Secondary Schooling $\times$ PM2.5			-.0022 (.0034)			-.0018 (.0040)
Rural				.0633 (.1151)		.0685 (.1154)
Rural x PM2.5				.0043 (.0026)		.0036 (.0025)
Interviewed Outdoor	.0376 (.0306)	.0378 (.0309)	.0372 (.0311)	.0399 (.0309)	.0832** (.0301)	.0695** (.0301)
Interviewed Outdoor x PM2.5					-.0037 (.0021)	-.0023 (.0020)
Temperature ($^{\circ}$ C)	.0002 (.0009)	.0001 (.0009)	.0002 (.0007)	.0008 (.0008)	.0002 (.0008)	.0008 (.0008)
Geographic and Time FE	YES	YES	YES	YES	YES	YES
Number Observations	5131	5131	5131	5131	5131	5131
Adjusted R-squared	.118	.118	.118	.119	.118	.118

Notes: This table presents the estimated association between PM_{2.5} exposure and a visuospatial index, with interactions by gender, age, education, rural residence, and interview setting. The visuospatial index captures spatial reasoning and constructional ability, is standardized to have mean zero and unit standard deviation, and is constructed via confirmatory factor analysis as part of the broader cognitive battery (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. Interaction variables are defined as follows: Female is a binary indicator equal to one for female respondents; Age ≥ 37 is a binary indicator equal to one for respondents aged 37 or older in 2023, where 37 is the median age in the sample; Any Secondary Schooling equals one if the respondent completed 9 or more years of schooling; Rural equals one for respondents in rural survey locations; and Interviewed Outdoor equals one if the assessment was conducted outdoors. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature and mean humidity. All regressions include hour-of-day, day-of-week, month, and geographic fixed effects. Columns (1), (3), (4), and (5) control for continuous age in years. Column (6) includes all interaction terms simultaneously. Standard errors, clustered at the geographic level, are reported in parentheses. Statistical significance is denoted as follows: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table S14: Robustness using PM_{2.5} exposure from the previous 2 hours window

	(1) General Cognitive	(2) Orientation	(3) Memory	(4) Executive Function	(5) Language	(6) Visuospatial
Mean PM2.5	-.0029** (.0013)	-.0001 (.0017)	-.0028 (.0018)	-.0025** (.0009)	-.0004 (.0011)	-.0018 (.0011)
Lagged Mean PM2.5	.0003 (.0010)	-.0001 (.0012)	.0004 (.0010)	.0002 (.0008)	.0007 (.0009)	-.0015** (.0007)
Temperature (°C)	.0003 (.0014)	-.0049*** (.0016)	.0012 (.0009)	-.0012 (.0019)	-.0013 (.0024)	.0003 (.0008)
Interviewed Outdoor	.0840* (.0455)	.0739** (.0265)	.0665* (.0359)	.0770* (.0428)	.0597 (.0612)	.0381 (.0311)
Female	-.1464*** (.0442)	-.1025* (.0514)	.0172 (.0386)	-.2817*** (.0342)	-.0578 (.0368)	-.3184*** (.0275)
Age	-.0331*** (.0034)	-.0133*** (.0024)	-.0310*** (.0035)	-.0333*** (.0049)	-.0107*** (.0033)	-.0072 (.0042)
Any Secondary Schooling	.7594*** (.0250)	.2789*** (.0213)	.5984*** (.0254)	.6862*** (.0163)	.6165*** (.0293)	.5322*** (.0165)
Number Observations	5067	5067	5067	5067	5067	5067
Adjusted R-squared	.208	.063	.129	.194	.128	.118

Notes: This table presents a robustness check using PM_{2.5} exposure from the previous two hours to examine whether pre-interview pollution exposure independently predicts cognitive performance. The dependent variables are standardized cognitive indices (mean zero, unit standard deviation) constructed via confirmatory factor analysis (see [Gross et al. \(2025\)](#)): Column (1) reports results for the general cognitive index, which incorporates orientation, memory, executive function, language, and visuospatial subdomains; Columns (2)–(6) report results for each subdomain separately. PM_{2.5} is measured using Atmotube devices. The contemporaneous measure is the mean reading during the interview window. The lagged measure is the mean reading in the period up to two hours before the interview start; because the Atmotube device was occasionally powered on shortly before fieldwork began, the mean available lag window is approximately 101 minutes. The top 2.5% of contemporaneous PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature, mean humidity, interview setting (indoor vs. outdoor), gender, age, and an indicator for any secondary schooling, as well as hour-of-day, day-of-week, month, and geographic fixed effects. Standard errors, clustered at the geographic level, are reported in parentheses. Statistical significance is denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table S15: Robustness to Alternative Geographic Fixed Effects

	(1)	(2)	(3)	(4)
	General Cognitive	General Cognitive	General Cognitive	General Cognitive
Mean PM2.5	-.0030** (.0011)	-.0032** (.0012)	-.0029** (.0011)	-.0023** (.0010)
Temperature (°C)	.0002 (.0014)	.0004 (.0013)	.0003 (.0016)	-.0001 (.0019)
Interviewed Outdoor	.0871* (.0455)	.0997** (.0437)	.0923* (.0434)	.0894* (.0428)
Female	-.1529*** (.0478)	-.1486*** (.0482)	-.1407*** (.0467)	-.1383*** (.0462)
Age	-.0333*** (.0036)	-.0332*** (.0036)	-.0342*** (.0042)	-.0346*** (.0042)
Any Secondary Schooling	.7618*** (.0227)	.7671*** (.0210)	.7662*** (.0205)	.7684*** (.0195)
Geographic FE	Approach 1	Approach 2	Approach 3	Approach 4
Number Observations	5131	5126	5131	5131
Adjusted R-squared	.210	.208	.204	.201

Notes: This table reports estimates of the association between contemporaneous PM_{2.5} exposure and the general cognitive index under four alternative definitions of geographic fixed effects. The general cognitive index is standardized to have mean zero and unit standard deviation and is constructed via confirmatory factor analysis over orientation, memory, executive function, language, and visuospatial subdomains (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. Approach 1 uses the original geographic classification shown in Figure 1, which distinguishes major urban areas (Busia Urban, Kisumu, Mombasa, Nairobi, Nakuru, Kampala), Busia Rural, the primary Kenyan provincial regions (Western, Nyanza, Coast, Central, Eastern, Rift Valley, North Eastern), and residual Other Urban and Other Rural categories. Approach 2 replaces this with fixed effects for each Kenyan county represented in the sample. Approach 3 uses fixed effects based on a coarser town-level categorization, including Busia Town, Eldoret, Kisumu, Mombasa, Nairobi, Nakuru, Kampala, an Other City/Large Town group, and a rural category. Approach 4 replaces these classifications with a simple urban–rural fixed effect. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All specifications control for mean temperature, mean humidity, interview setting (indoor vs. outdoor), gender, age, and an indicator for any secondary schooling, and include hour-of-day, day-of-week, and month fixed effects. Standard errors are clustered at the Approach 1 geographic level and reported in parentheses. Statistical significance is denoted as: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table S16: Associations between residualized PM_{2.5} exposure and individual characteristics

	(1)	(2)	(3)	(4)
<i>Panel A: Any secondary schooling</i>				
Residualized PM2.5	0.0003 (0.0008)	0.0002 (0.0009)	0.0004 (0.0008)	0.0004 (0.0007)
Geographic FE	Approach 1	Approach 2	Approach 3	Approach 4
Number of Observations	5,153	5,148	5,153	5,153
<i>Panel B: Female</i>				
Residualized PM2.5	0.0002 (0.0005)	0.0001 (0.0005)	0.0003 (0.0005)	0.0004 (0.0005)
Geographic FE	Approach 1	Approach 2	Approach 3	Approach 4
Number Observations	5,264	5,259	5,264	5,264
<i>Panel C: Age</i>				
Residualized PM2.5	-0.0035 (0.0032)	-0.0036 (0.0031)	-0.0038 (0.0031)	-0.0047 (0.0033)
Geographic FE	Approach 1	Approach 2	Approach 3	Approach 4
Number Observations	5,242	5,237	5,242	5,242
Joint F-test p-value	0.710	0.686	0.666	0.532

Notes: Each cell reports the coefficient from a bivariate regression of the indicated individual characteristic on residualized PM_{2.5}. PM_{2.5} is first residualized with respect to mean temperature, mean humidity, interview setting (indoor vs. outdoor), and hour-of-day, day-of-week, and month fixed effects under each of four alternative geographic fixed-effects definitions. The four approaches differ in the definition of geographic fixed effects; details are provided in Appendix Table S15. Any Secondary Schooling equals one if the respondent completed 9 or more years of schooling. Female is a binary indicator. Age is measured in years as of 2023. The joint F -test p -value is from a regression of residualized PM_{2.5} on Any Secondary Schooling, Female, and Age, testing the null that all three coefficients are jointly equal to zero under the corresponding geographic fixed-effects approach. Standard errors, clustered at the Approach 1 geographic level, are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table S17: Robustness to selection on unobservables

	(1) Baseline	(2) Full Controls	(3) Oster Bound
Mean PM2.5	-.0026** (.0011)	-.0030** (.0011)	-.0031
Temperature (°C)	.0007 (.0017)	.0002 (.0014)	
Interviewed Outdoor	.1711*** (.0497)	.0871* (.0455)	
Female		-.1529*** (.0478)	
Age		-.0333*** (.0036)	
Any Secondary Schooling		.7618*** (.0227)	
Geographic and Time FE	YES	YES	YES
Number Observations	5264	5131	5131
Adjusted R-squared	.038	.210	
Maximum R-squared			.273
Implied Delta for Beta=0			3.17

Notes: This table presents bounds on the estimated association between contemporaneous PM_{2.5} exposure and the general cognitive index following the selection-on-observables approach of [Oster \(2019\)](#). The general cognitive index is standardized to have mean zero and unit standard deviation and is constructed via confirmatory factor analysis over orientation, memory, executive function, language, and visuospatial subdomains (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All specifications include hour-of-day, day-of-week, month, and geographic fixed effects. Column (1) controls for mean temperature, mean humidity, and interview setting (indoor vs. outdoor). Column (2) additionally controls for gender, age, and an indicator for any secondary schooling. Column (3) reports the bias-adjusted coefficient β^* computed under $\delta = 1$ and $R_{\max} = 1.3 \times \tilde{R}^2$ from the full specification in Column (2). The parameter δ measures the relative degree of selection on unobserved confounders compared to selection on observed controls; $\delta = 1$ assumes that unobservables are equally important as observables in explaining selection into PM_{2.5} exposure. The final row reports the value of δ required for the estimated treatment effect to equal zero ($\beta^* = 0$). Standard errors, clustered at the geographic level, are reported in parentheses.

Table S18: Robustness to Interview Setting

	(1) General Cognitive	(2) General Cognitive No Control	(3) General Cognitive Indoor Only	(4) General Cognitive Outdoor Only
Mean PM2.5	-.0030** (.0011)	-.0031** (.0011)	-.0030*** (.0010)	-.0031* (.0017)
Temperature (°C)	.0002 (.0014)	-.0001 (.0015)	-.0007 (.0022)	.0012 (.0021)
Interviewed Outdoor	.0871* (.0455)			
Female	-.1529*** (.0478)	-.1642*** (.0429)	-.1313*** (.0325)	-.2000** (.0811)
Age	-.0333*** (.0036)	-.0334*** (.0036)	-.0307*** (.0043)	-.0373*** (.0068)
Any Secondary Schooling	.7618*** (.0227)	.7650*** (.0245)	.7548*** (.0196)	.7915*** (.0637)
Geographic and Time FE	YES	YES	YES	YES
Number Observations	5131	5131	3638	1493
Adjusted R-squared	.210	.209	.197	.215

Notes: This table examines the sensitivity of the estimated association between PM_{2.5} exposure and general cognitive performance to interview setting (indoor vs. outdoor). The general cognitive index is standardized to have mean zero and unit standard deviation and is constructed via confirmatory factor analysis over orientation, memory, executive function, language, and visuospatial subdomains (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. Column (1) reports the preferred baseline specification using the full sample, controlling for an outdoor indicator. Column (2) drops the outdoor control. Column (3) restricts the sample to interviews conducted indoors only. Column (4) restricts the sample to interviews conducted outdoors only. The top 2.5% of PM_{2.5} values are trimmed to reduce the influence of extreme outliers. All regressions control for mean temperature, mean humidity, gender, age, and an indicator for any secondary schooling. All regressions include hour-of-day, day-of-week, month, and geographic fixed effects. Standard errors are clustered at the geographic level and reported in parentheses. Statistical significance is denoted as follows: *** p<0.01, ** p<0.05, * p<0.1.

Table S19: Robustness to Trimming

	Trimmed		Winsorized		Alternative Specifications		
	(1) Top 2.5%	(2) Top 1%	(3) Top 2.5%	(4) Top 1%	(5) Untrimmed	(6) Median	(7) Log
Mean PM2.5	-.0030** (.0011)	-.0012** (.0004)	-.0016** (.0007)	-.0009 (.0007)	-.0005 (.0006)		
Median PM2.5						-.0011 (.0010)	
Log Mean PM2.5							-.0226* (.0120)
Temperature (°C)	.0002 (.0014)	-.0002 (.0012)	-.0001 (.0013)	-.0003 (.0012)	-.0004 (.0012)	-.0055 (.0053)	-.0002 (.0013)
Interviewed Outdoor	.0871* (.0455)	.0927* (.0458)	.0917* (.0471)	.0922* (.0468)	.0924* (.0467)	.0938* (.0461)	.0921* (.0470)
Female	-.1529*** (.0478)	-.1506*** (.0491)	-.1546*** (.0478)	-.1547*** (.0479)	-.1547*** (.0480)	-.1500*** (.0433)	-.1543*** (.0475)
Age	-.0333*** (.0036)	-.0330*** (.0034)	-.0338*** (.0034)	-.0338*** (.0034)	-.0338*** (.0034)	-.0332*** (.0036)	-.0339*** (.0034)
Any Secondary Schooling	.7618*** (.0227)	.7637*** (.0219)	.7602*** (.0213)	.7599*** (.0213)	.7599*** (.0213)	.7643*** (.0190)	.7595*** (.0213)
Geographic and Time FE	YES	YES	YES	YES	YES	YES	YES
Number Observations	5131	5210	5263	5263	5263	5199	5263
Adjusted R-squared	.210	.211	.210	.210	.210	.212	.210

Notes: This table examines the sensitivity of the estimated association between contemporaneous PM_{2.5} exposure and the general cognitive index to alternative treatments of extreme PM_{2.5} values and alternative exposure summaries. The general cognitive index is standardized to have mean zero and unit standard deviation and is constructed via confirmatory factor analysis over orientation, memory, executive function, language, and visuospatial subdomains (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured using Atmotube devices. All specifications control for mean temperature, mean humidity, interview setting (outdoor indicator), gender, age, and an indicator for any secondary schooling. All regressions include hour-of-day, day-of-week, month, and geographic fixed effects. Column (1) reports the preferred baseline specification trimming the top 2.5% of PM_{2.5} observations. Column (2) trims the top 1%. Column (3) winsorizes PM_{2.5} at the 97.5th percentile. Column (4) winsorizes PM_{2.5} at the 99th percentile. Column (5) uses the full, untrimmed sample. Column (6) replaces mean PM_{2.5} with median PM_{2.5} during the interview window. Column (7) models PM_{2.5} in natural logs. Standard errors are clustered at the geographic level and reported in parentheses. Statistical significance is denoted as follows: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table S20: Robustness to Extreme Temperature and Humidity

	(1) General Cognitive Baseline	(2) General Cognitive Drop Humidity>80%	(3) General Cognitive Drop Extreme Temp	(4) General Cognitive Drop Both
Mean PM2.5	-.0030** (.0011)	-.0030** (.0011)	-.0030** (.0010)	-.0030** (.0010)
Temperature (°C)	.0002 (.0014)	.0002 (.0014)	-.0047 (.0076)	-.0052 (.0074)
Interviewed Outdoor	.0871* (.0455)	.0880* (.0456)	.0863* (.0446)	.0872* (.0447)
Female	-.1529*** (.0478)	-.1522*** (.0478)	-.1411*** (.0458)	-.1403*** (.0457)
Age	-.0333*** (.0036)	-.0333*** (.0036)	-.0320*** (.0038)	-.0321*** (.0038)
Any Secondary Schooling	.7618*** (.0227)	.7616*** (.0228)	.7654*** (.0200)	.7651*** (.0201)
Geographic and Time FE	YES	YES	YES	YES
Number Observations	5131	5127	5001	4997
Adjusted R-squared	.210	.210	.210	.210

Notes: This table examines the sensitivity of the estimated association between contemporaneous PM_{2.5} exposure and the general cognitive index to the exclusion of observations recorded under extreme temperature or humidity conditions. The general cognitive index is standardized to have mean zero and unit standard deviation and is constructed via confirmatory factor analysis over orientation, memory, executive function, language, and visuospatial subdomains (see [Gross et al. \(2025\)](#)). PM_{2.5} is measured as the mean Atmotube reading ($\mu\text{g}/\text{m}^3$) during the cognitive assessment interview window. Column (1) reports the preferred baseline specification using the full trimmed sample. Column (2) drops observations with mean humidity above 80%. Column (3) drops observations with mean temperature below 10°C or above 40°C. Column (4) drops observations meeting either the high-humidity or extreme-temperature criteria. The top 2.5% of PM_{2.5} values are trimmed in all columns to reduce the influence of extreme outliers. All regressions control for mean temperature, mean humidity, interview setting (indoor vs. outdoor), gender, age, and an indicator for any secondary schooling. All regressions include hour-of-day, day-of-week, month, and geographic fixed effects. Standard errors are clustered at the geographic level and reported in parentheses. Statistical significance is denoted as follows: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.